

MARINE REVIEW.

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REVIVAL OF LAKE SHIP BUILDING.

NEARLY HALF AS MUCH TONNAGE ALREADY CONTRACTED FOR NEXT SEASON AS WAS BUILT DURING THE ENTIRE YEAR OF 1891. PROSPECTIVE CONTRACTS THAT WILL FILL UP ALL LAKE SHIP YARDS—VALUATION OF VESSELS NOW UNDER CONTRACT, \$2,807,800; CARRYING CAPACITY 49,500 TONS.

The following table will assist ship builders and vessel owners to realize that the capacity of new vessels to be built in 1896 will eclipse the records of 1891, when vessels aggregating over 111,000 tons carrying capacity were put forth from lake ship yards. Greater dimensions in modern lake carriers is the cause of the great increase in capacity. History is again repeating itself in the lake trade and one of the 400-foot ships of today will carry as much as three of the steamers that were in the lead less than ten years ago. The fall period when orders for new ships are placed has hardly been reached, but the situation has been anticipated and thirteen steel vessels are already under contract. The list does not include any of the vessels contracted for some time ago, and which have been so far completed that they will engage in service of any kind during the closing months of the present season. Ten of the new vessels are steel steamers of the largest and best class and three are steel tow barges. One of the steam vessels is a revenue cutter for the government and another is a side-wheel passenger boat. Exclusive of these two ships, which will take no part in carrying freight, the other new vessels will have a combined carrying capacity of 49,500 net tons on 16 feet draft. The valuation of all thirteen vessels is about \$2,807,800. On December 1 of last year—three months later than the present date, when orders were well covered—the capacity of freight vessels under contract was but 30,250 tons, and their valuation, exclusive of the passenger steamer North Land and the Cleveland & Buffalo Transit Co.'s steamer, which was then in contemplation, was only \$1,870,000. The list of ships now under contract follows:

NEW VESSELS UNDER CONTRACT IN LAKE SHIP YARDS SEPT. 1, 1895—
FOR SERVICE IN 1896.

	Capacity, estimated, net tons, on 16 feet draft.	Value, estimated
F. W. WHEELER & CO., WEST BAY CITY, MICH.—		
One 400-foot steel steamer for Eddy Bros. & Shaw, Bay City Mich.....	5,000	\$265,000
One 400-foot steel steamer for Roby and others, Detroit, Mich.....	5,000	265,000
One 378-foot steel steamer for D. C. Whitney, Detroit, Mich.....	4,500	240,000
One 386-foot steel steamer for John Mitchell and others, Cleveland, O....	4,750	245,000
CHICAGO SHIP BUILDING CO., SOUTH CHICAGO, ILL.—		
One 375-foot steel steamer for C. W. Elphicke and others, Chicago.....	4,500	240,000
Two steel tow barges for Minnesota Steamship Co., Cleveland.....	7,000	180,000
One steel tow barge for Northwestern Transportation Co., Cleveland....	3,500	90,000
CLEVELAND SHIP BUILDING CO., CLEVELAND, O.—		
One 395-foot steel steamer for Wilson Transit Co., Cleveland	4,750	250,000
One 400-foot steel steamer for A. B. Wolvin, Duluth, Minn	5,000	260,000
GLOBE IRON WORKS CO., CLEVELAND, O.—		
One 415-foot steel steamer for the builders.....	5,500	275,000
One U. S. revenue cutter for Treasury Department		147,800
DETROIT DRY DOCK CO., DETROIT, MICH.—		
One side-wheel passenger steamer for C. & B. Transit Co., Cleveland.....		350,000
	49,500	\$2,807,800

NOTE.—Valuations are approximate and may appear a little high, but advancing tendency of prices warrants figures somewhat above actual contract prices.

It is evident from the foregoing figures and from the present outlook regarding next season's business, which warrants the payment of \$1 or better per ton on ore contracts, that another period of prosperity in the lake business is at hand, and that the ship building industry has little to fear from the 20-foot channel and like improvements. While it is true that in the modern 400-foot freighter the capacity of lake vessels is increased 1,000 to 1,500 tons each this will be more than offset by the fact that a large number of the wooden steamers will in the meantime be turned into trades that are not considered competitive in the general cargo business. The fact also remains that the passenger steamer business of the lakes is in its infancy. An impetus has been given to the passenger business by the building of the steamers North West and North Land, and negotiations for other vessels of equal magnitude are actually under way, although it may take some time to develop the details. This demand for passenger ships which must ultimately develop

in a very forcible way is an important matter to be kept in view by ship builders.

In addition to contracts noted in the table, there is undoubtedly enough more work in view to fill up all lake ship yards until next spring. Mr. Frank E. Kirby and Mr. Gilbert N. McMillan of the Detroit Dry Dock Company are in St. Petersburg closing up a contract with the Russian government that is said to amount to \$2,000,000 for car ferry steamers on Lake Baikal. This contract may not involve a great deal of work at the Detroit yard, but it is, of course, very probable that an announcement of a new contract or the putting down of a ship or two under arrangements with patrons of the Detroit concern will be heard shortly.

The Cleveland Steel Canal Boat Company decided at a meeting this week to build four steam canal boats and twenty consorts for their Lake Erie—Erie canal trade. The contract for this fleet of twenty-four small barges will in all probability be given to the Globe company of Cleveland. As yet the Union Dry Dock Co. of Buffalo makes no announcement of new work farther than the preparation of plans for a steel steam yacht, but it is quite probable that a contract of some importance will fall to this concern later, as its facilities admit of the construction of large steel vessels.

James McBrier of Erie and the Cleveland-Cliffs Iron Co. have been figuring on steel tow barges for some time past, and the American Steel Barge Co. has just finished plans for a type of consort on which two or three orders are expected.

The Goodrich Transportation Co. and the Graham & Morton Transportation Co. will no doubt place orders shortly for wooden passenger steamers on which they have been figuring for some time past. Other negotiations of a less definite character, including a steel steamer of moderate size for a Cleveland syndicate and a wooden vessel for one of the Cleveland lumber companies, are also under way.

Yards devoted to the building of wooden vessels, which find place for one or more keels, when freight conditions are promising as at present, will be heard from later on. These include C. T. Morley and Curtis & Brainard of Marine City, Mich., the Jenks Ship Building Co. of Port Huron, Mich., and James Davidson of West Bay City, Mich. The several smaller concerns on Lake Michigan may also be expected to find work enough in the construction of tugs and small pleasure craft to keep them busy during the winter. Dunham & Hausler, South Chicago, are figuring on a harbor tug of the best class.

Merchant ship building in the coast yards is also in a better condition than for several years. The Newport News (Va.) Ship Building & Dry Dock Co. has three passenger steamers that will aggregate in value \$1,500,000. Wm. Cramp & Sons, Philadelphia, have two steamers for the Red D line and one for the Clyde line, the total value of which is about \$1,300,000. The Delaware River Iron Ship Building and Engine Works, Chester, Pa., is building two freight steamers for the Vermont Central line—vessels which would probably have been built on the lakes if they had not been needed immediately. John Englis & Son, Brooklyn, N. Y., will build a \$1,000,000 passenger steamer for the Hudson River Navigation Co., New York, and in Maine yards there are several wooden schooners under way.

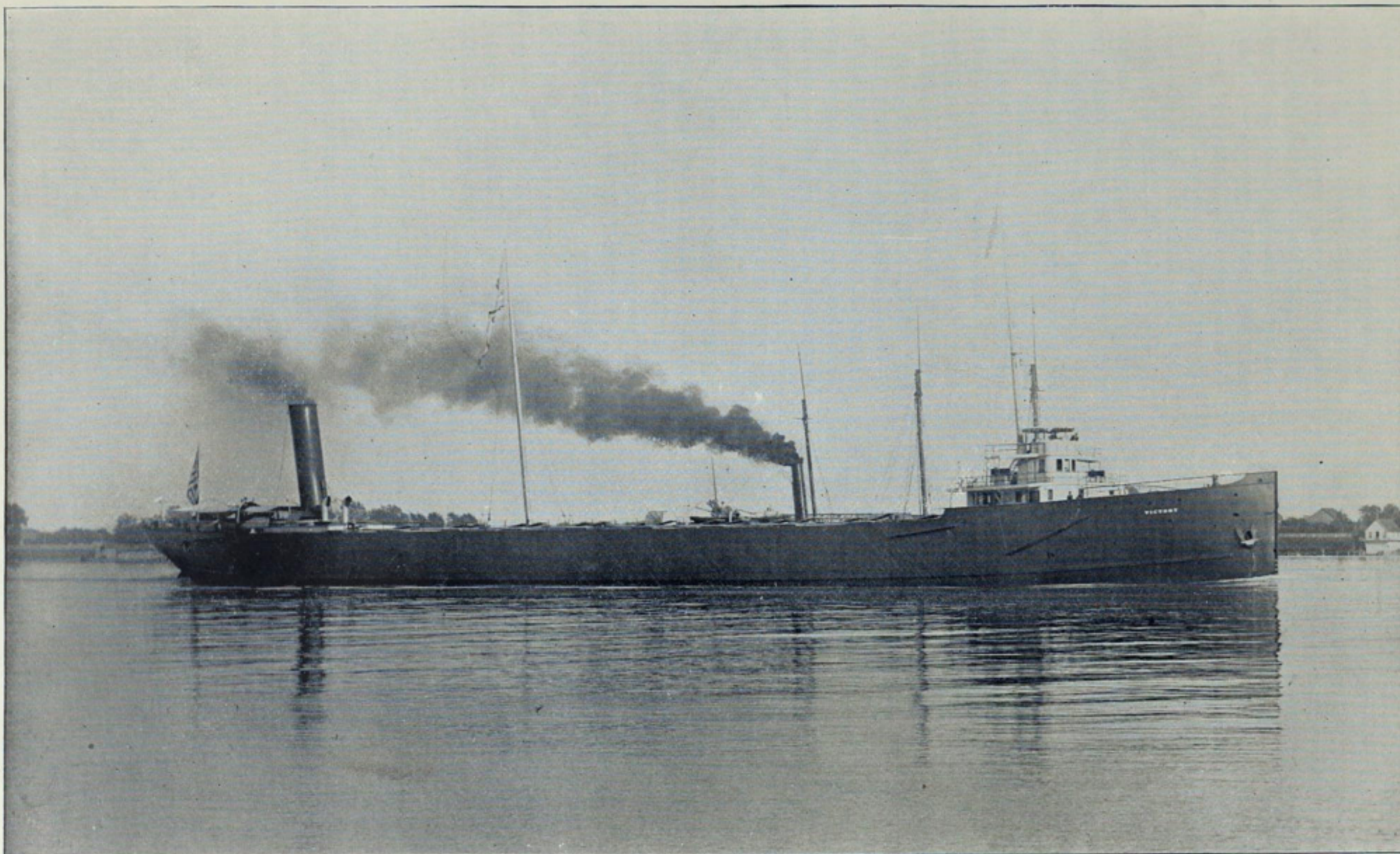
Stocks of Grain at Lake Ports.

The following table, prepared from reports of the Chicago board of trade, shows the stocks of wheat and corn in store at the principal points of accumulation on the lakes on Sept. 7, 1895:

	Wheat, bushels.	Corn, bushels.
Chicago.....	14,299,000	1,255,000
Duluth.....	4,082,000
Milwaukee.....	537,000
Detroit.....	455,000	34,000
Toledo.....	1,094,000	93,000
Buffalo.....	1,369,000	217,000
Total.....	21,835,000	1,599,000

As compared with a week ago, the above figures show at the several points named a decrease of 278,000 bushels of wheat and 365,000 bushels of corn.

LAKE ERIE AND LAKE ONTARIO ON ONE SHEET, THE THIRD OF THE HYDROGRAPHIC OFFICE SERIES OF CHARTS, IS NOW IN PRINT AND MAY BE HAD FROM THE MARINE REVIEW, 516 PERRY-PAYNE BUILDING. PRICE 75 CENTS.



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STEEL STEAMER VICTORY,
OWNED BY THE INTER-LAKE CO.—BUILT BY THE CHICAGO SHIP BUILDING CO.
(ONE OF THE TWO LARGEST STEAMERS ON THE LAKES.)

A Few Tips on The Future.

These are stirring days in and around the Perry-Payne building, Cleveland. A jump from 90 cents to \$1.25 in Lake Superior ore freights within a fortnight is by no means a matter of little significance. It has recalled stories of the days—only a few years ago—when \$2.75 a ton was paid on contracts from Ashland, and when shippers had representatives out in all directions, looking up not only vessels that were in service, but also such of them as were on the stocks and would be available at any time during the following season. The vessel owner who has carried around a long face for two years past, and who had about given up all hope of a return to profitable rates in the business, is no longer in evidence,—at least, when the future of the freight market is under discussion. But the faces are not all of the smiling kind. The owner who has 75 or 80 cent ore yet to haul down from Duluth or Ashland is not heard from very forcibly when the smiles are being passed around. M. M. Drake of Buffalo admitted as much when he had to send the big steamer Chili, a few days ago, for a contract ore cargo and leave 3½-cent wheat in Duluth. He may find a little consolation in knowing, however, that if all the brethren in the vessel business would acknowledge the corn the number of them to take full advantage of the present situation would be very small. There are only a few of them. M. A. Bradley, of Cleveland, is among the fortunate ones. He had just accepted a block of ore from the head of the lakes at \$1.40 for the balance of the season, when he announced in a little group of enthusiasts on Saturday last that he would wager a suit of clothes on \$1.25 being paid for carrying soft coal to Milwaukee before the snow flies. He found no takers, and it is quite safe to assume that his judgment is good, as the coal men have been full sixty days late in awakening to present conditions. They are not refusing to take "hens" now. This was the term applied to consorts when ships were plentiful and coal cargoes scarce.

Mr. Bradley's enthusiasm regarding freights is not, however, prompting him to build more ships. Alike to a few other owners who have been going it alone he is inclined to lay low against such combinations as the Minnesota company and the Rockefeller syndicate. He is not altogether inclined to the opinion that careful attention to detail on the part of individuals in the vessel business is an advantage sufficient to cope with consolidated interests that are fast coming into control, even if these interests are managed by hired men who do not watch all the leaks. However this may be, it is certain that for this fall and another year at least a few owners like Messrs. Bradley, Corrigan and one or two others who have held out against odds on the "bull" side of the market and who have had a long wait, will profit by the present turn in affairs. It is common talk that James Corrigan is making more money, in proportion to his interests, than anybody else in or around Cleveland in the pig iron business. If such is the case there are few who will begrudge it to him. He is deserving of profit from his ships as well, if a long and steady pull towards good freights counts for anything.

Capt. Alex McDougall of the American Steel Barge Co., has just made a trip through lower lake cities. He was in Cleveland a few days ago. "My interests are largely in transportation," he said, "and I have been making careful inquiry regarding business for another year. I am firmly of the opinion that if all the vessel owners could be induced to take part in an excursion to Florida or some other distant point just as soon as the season of navigation is at an end the result would be highly advantageous. I know that the increase in wheat to be moved from the Dakotahs and Manitoba is the greatest ever known. As regards this feature in the situation I am fully acquainted, and I know from talking with leading grain men in Chicago that when the immense corn crop begins to seek storage capacity soon after the close of navigation the situation will be strengthened beyond the greatest hopes of vessel owners. If they will only ward off all inducements to tie up vessels at what may now seem like favorable freights, they will get better than the present dollar offers on ore and there will be far more than enough business to go around,

Capt. McDougall has lost none of the enthusiasm that always accompanies his reference to the Mesabi iron range of Minnesota. He made a trip over the range recently and is quoted as saying that there is 200,000,000 tons of ore in sight at the various properties, about half of which he thinks is Bessemer. He holds to the opinion that the Mesabi is the key to a foreign trade in iron and that its full development with more advantageous use of the ores will with cheaper water transportation to the seaboard, eventually result in this country building up a big foreign market for iron and steel products.

Iron Ore Shipments.—Lake Freights.

Sales of Bessemer ore of the best grade at \$4.50 for delivery this season have been reported during the past week. Transactions of this kind are, of course, limited but they indicate a probable advance of \$1.25 over last spring's prices for ore to be delivered next year. On this basis

lake freight contracts, to share only a moderate portion of the advance in ore, should be made at \$1.25, but there is no sympathy in cold business dealings, and it is a fact that several of the ore companies have already had offers from vessel owners to charter for next season at \$1. This is not proof that all vessel owners are ready to charter at that figure. Neither are the ore dealers ready to open up negotiations for next year's ore and thus far nothing settling another season's business has been done. Notwithstanding advances in lake freights during the past week, that have exceeded the brightest hopes of vessel owners, and a continuance of the stubborn struggle with ore miners on the Marquette range, shipments from all upper lake ports during August, as officially reported to the Cleveland association of ore sales agents, foot up 1,678,116 gross tons, and the aggregate of the season to Sept. 1 is 6,672,051 gross tons, against 4,886,487 tons on the corresponding date in 1894. With such announcements as an advance of \$4 a ton in steel rails, bringing the price up to \$28, and with the product of pig iron furnaces throughout the country practically sold up for several months to come, at prices that are in some cases almost double what they were a few months ago, it is plain that the season's output of iron ore will be limited only by the capacity of the mines. Production will however, be cut short to a degree that will leave some of the properties on the Mesaba range short of filling their engagements with the furnaces, but for the present, at least, everything is being rushed, and lake freights, urged on by a steady movement of grain out of Duluth at 3½ cents, have reached a basis of \$1.25 from the head of Lake Superior. On some business extending through the balance of the season \$1.40 has been paid.

This condition in ore is, of course, altogether dependent on the grain movement. With only moderate grain shipments the ore that it is possible to produce from this time on would not be sufficient in quantity to pay anything like the present rates, but fortunately for the vessel interests the indications all point to a continuance of grain shipments, on account of unprecedented crops. Eastern storage capacity may become blocked and the grain movement stopped; or a car famine, on account of the heavy strain being put upon the railways in all directions, may bring about the same result, but for the present these conditions are not being considered, and the freight market is steadily advancing. Lumber dealers who have large quantities of lumber to move from the head of Lake Superior are at this writing getting few vessels at \$2.62½ to Chicago. The Escanaba ore rate is 80 cents. Marquette shippers are getting no wild tonnage.

Lake Superior coal freights have not as yet gone up with the advances in ore and grain, and it would seem that the coal interests have been too long indifferent to the situation. Last year there was moved through the St. Mary's Falls canal 2,264,314 net tons of soft coal and 532,870 tons of hard coal. On the first of the present month soft coal shipments through the canal footed up only 1,063,476 tons and hard coal only 196,638. The shortage to Lake Michigan is even greater. It is true that 500,000 tons of coal was carried over at the head of Lake Superior this spring, but now every wheel is moving in the Lake Superior country as against business depression everywhere a year ago. Coal carried over last winter might be replaced during the past spring at a reduced price on account of lower mining costs and lower charges generally. All this is changed now. Higher mining charges are certain and any coal carried over during the coming winter would increase in value.

What is the Outflow of the Lower Lakes.

The REVIEW is in receipt of an official copy of the report of the board of army engineers, consisting of Col. O. M. Poe and Majors E. H. Ruffner and W. L. Marshall, appointed to consider and report upon the probable effect of the operation of the Chicago drainage canal upon the lake and harbor levels and upon the navigation of the great lakes and their connecting waterways. The engineers did not spend a great deal of time on their task. They evidently understood from the outset that the best they could do would be to recommend to the department that further observations be made of the outflow of the St. Clair and Niagara rivers, as in the absence of reliable data regarding the outflow of the lower lakes all estimates of the effect of the canal on lake channels and harbors were merely conjecture. The report is not therefore a document containing very much that is new on the subject. The engineers spent two days looking over the drainage canal work and their report is prefaced by a short description of the canal. They have also incorporated in their report the document recently prepared by Thos. T. Johnson, assistant chief engineer of the canal, which presents the subject as viewed by the canal officials. The engineers submit also, without expression of opinion, the estimate prepared some time ago by Mr. Charles H. Keep, secretary of the Lake Carriers' Association, of the commercial losses in carrying capacity of the lake fleet should a reduction be made in the lake levels of 1, 3 or 6 inches. These letters and papers have all appeared in the REVIEW since discussion of the canal question has been renewed. Starting out with the query "What is the outflow of the lower lakes," the board says:

"In November 1891, the chief of engineers, U. S. A., at the request of the secretary of the American Society of Civil Engineers, (who had been asked by the chief engineer of the Montreal harbor commission of Canada to suggest the subject,) ordered a set of observations made to determine the amount of water flowing down the Niagara river. The time was especially propitious as the water was then very low. The results of these measurements were somewhat unexpected, and they were repeated in May 1892. The second set corroborated the first, and the whole formed the subject of a report to the chief of engineers, which appeared in his annual report of 1893, pages 4364 and following. But, as the subject was important, the Engineering News anticipated the appearance of the official report by publishing in its issue of March 8, 1893, this report, with the permission of the chief of engineers. This publication was the first ever made in which as a result of careful measurements a relation between the level of the lakes, and their outflow, or discharge had been established, and given to the public. Prior determination of this discharge had not attempted to detect this relation, and nothing more than a general determination of a season's work had been published.

"In all plans for the Chicago drainage canal the early measurements had been taken, and those studying the subject chose such isolated figures as suited them best. The report of 1892, being so late in appearance, long after the drainage canal was put under construction, escaped the notice of many who are interested in navigation, for two reasons. Some were too busy to see anything, unless specially brought to their notice. Others thought the whole matter already fully canvassed, and settled. It is true there is nothing showing that the consent of congress had been asked for this enterprise; certain that the subject had not been treated as an interstate affair; to say nothing of its being an international affair. The United States has always been slow to move; with its many sleeping rights it has for many years been loath to exercise them. Not till 1888 did it begin to exercise positive legislation over its navigable waters in order to preserve them for all its citizens. Each river and harbor bill since then is found to have sections strengthening the hands of those who wish to keep the waterways open, and in good order for all classes of navigators. Not till 1890 had any prohibitive clauses been enacted into laws forbidding, for example, the destruction of channels by improper dumpings. Saw mills went their own unchecked way every year of clogging up the streams. Railroads bridged all smaller streams, in the states, without interference from the United States. Many other features can be quoted. But it is sufficient to say that all that is now changed. The adopted policy is to defend, as well as improve all water courses, now navigable, or probably navigable in the reasonably close future. Waterways are under the charge of the United States, and there is no likelihood of their being abandoned for some time to come.

"With this an established fact it is impossible to think that United States supervision shall not be extended to the Chicago drainage canal in due time. Under whatever law built, and for whatever purpose constructed, just so soon as it is shown that that canal effects, or becomes a part of the system of navigable waterways of the United States, some supervision or control of it must follow. When boats use it for harbor purposes; when its waters add to the Illinois river, or take from the lakes, they alter natural conditions and the matter rises for consideration under national authority.

"The water levels of the great lakes are very delicate. Storms, barometric changes, rainfall, even tidal changes are felt. Records show at Buffalo no less than 13 feet as a total possible change, between the lowest and the highest gauge readings. Each lake is a basin. The water is constantly pouring in from not only one, but several inlets. The overflow, however, is now always out of the one outlet provided for that purpose; the second one, formerly at Chicago, has been plugged up.

"As in other basins when the water rises enough to take two, three or more of the small holes to carry it off, it is always to be noted that those holes are always carrying that surplus off; they do not wait until the water has time to pass from one end to the other. In the same channel the head alone governs the rate of outflow, and that head is measured by the gauge reading at the outlet. The supply of water in the lake—the net supply, allowing for evaporation—is the sole cause of the outflow. That supply depends solely upon rainfall, but the lake when it receives more than it has been receiving must discharge more; when it has less there is less to run out. If the outlet be dug down, or new ones made, the water runs off faster than it ran off before. The outflow is instantly affected by a changed inflow, provided there is enough such to increase or reduce the head. If we have a rainfall of one inch over the lake area, (and such are not uncommon events,) there is a head of one inch to run off. But if there are two outlets to run out of, instead of one, this inch must run off sooner than through the one.

"If the new outlet should reduce the levels of Lakes Michigan and Huron about six inches this effect will be produced in full in about two years; it is not then a question of many years as some suppose. We may feel very sure, therefore, that in this question two points are certain.

First, the drainage canal is not solely a state affair, but a national one; and second, the tapping the lakes must affect their levels. But it is said, first, that the changes in levels does not concern shippers, and then that at most the effects will be trifling. If one watched carefully the course pursued by shippers one would see that as a rule each vessel carries all that it can take, and get out of its port, or into that it intends to reach. Vessel owners and managers are very shrewd, watchful men; they know what they can safely carry allowing for storms and short detentions arising from passing causes; they average pretty well the practicable depths, and carry all the channels will stand. They are as conversant as are theorists about the effects of storms, but they keep good watch on ruling depths. Now should it be certain that these average depths were reduced 3 inches or 6 inches, they must load accordingly. And not only the large boats, but also the small ones using the small harbors that the large ones cannot go into. All must lose the 3 or 6 inches, as it may be, and not for one or more trips but for all trips and for all time; a diminution of capacity is not a single tax, but a continuous one. A vessel that when light draws 6 feet and loaded 12 feet, must lose 3 inches out of 72, say 4 per cent. in capacity each loading. A vessel drawing 12 feet light and 20 feet loaded, would lose somewhat over 3 per cent. in capacity at each and every loading. Should the loss of levels be 6 inches instead of 3, then these figures become doubled. Will the loss be 6 inches or will it be 3? This is an important question and we have only the Niagara river discharge observations from which to answer it. These cover a range of about 18 feet. There were scattering observations outside these limits, but the mass of results was secured between gauge readings, mean lake level, the highest, and 1'.85. The 'smooth curve' as published enables us to note the fall of 0'.53 on the gauge per 10,000 cubic feet per second for the first foot of fall and 0'.44 for the whole.

"These observations, especially at the lower readings, are erratic, and indicate a need for more measurements, especially at these levels. This lower portion of the gauge should be studied and additional observations made, and the board is a unit in suggesting the importance of a series of gaugings of the St. Clair river at the present time for this purpose, and to furnish additional knowledge of the relation between gauge readings and discharge. The subject is of such general bearing upon the navigation of the lakes, that it demands careful treatment and full data. The Niagara data do show how much Lakes Huron and Michigan would be lowered, even if 0'.53 were the net loss to Lake Erie. The opinion expressed by Mr. Johnston that the effect on the two upper lakes would be some 15 per cent. greater than upon Erie would seem to point to a probable loss of say 0'.61. This possible loss of 7 inches certainly is important enough to justify careful measurements of the discharge through the St. Clair. It is true that the law as it stands, and the intention of the trustees contemplates the abstraction of only 300,000 cubic feet under present conditions, but after the canal is opened measurements would not be so instructive, and we must assume that ultimately the entire 600,000 cubic feet per minute will be drawn from Lake Michigan as required by the state law. The abstraction of 10,000 cubic feet of water per second from Lake Michigan will lower the levels of all the lakes of the system except Lake Superior and reduce the navigable capacities of all harbors and shallows throughout the system to an extent that may be determined, if at all, by actual measurements only. Under the laws of the United States these changes in capacity cannot be made without federal authority, and to enable the executive officers of the United States to act advisedly in the matter it is necessary in the opinion of the board not only that these measurements be taken but that the money cost of restoring the navigable depths in channels and harbors be carefully estimated.

Referring especially to the effect of the canal on the Chicago river, the engineers say: "While the navigable capacity of all harbors and channels on the great lakes below St. Marys Falls will be injuriously affected by a diminution in depth, the navigability of the inner harbor of Chicago will be diminished also by the introduction of a current therein, which in the present condition of the river, even with the minimum flow of 5,000 cubic feet per second or 300,000 cubic feet per minute, is entirely inadmissible. The estimates of the effect of the drainage canal upon this harbor should also consider this element. The canal trustees have not yet determined upon a plan of treatment of this navigable channel and their plans may be such as may improve, impair or destroy its utility as a navigable river."

A contract has just been let by M. A. Hanna & Co. of Cleveland for more dock improvements and additional ore handling machinery on the Pennsylvania company's side of Ashtabula harbor. The new work will involve changes in one of the slips that will admit of ore steamers of the largest class reaching the No. 2 dock, on which the number of rigs will be increased to twelve, so that a ship carrying about 4,000 gross tons of ore may be unloaded in a day. When these improvements are completed the docks at Ashtabula controlled by M. A. Hanna & Co. will have facilities for handling 11,000 tons of ore and coal per day.

Success of the Steel Canal Barge Enterprise.

Although figures are not, of course, given out, it is understood that reports made to stockholders of the Cleveland Steel Canal Boat Co., after the first trip of five of the steel canal barges from Cleveland to New York and return by way of Lake Erie and the Erie canal, were of a kind that show very clearly that there is a fair return for stockholders to be had in the construction of more of the barges on the strength of contracts which the company now holds. With actual assurance of this kind the directors of the company have accordingly decided to build four more tows of one steamer and five barges each, or twenty-four vessels in all. The contract will very probably be given to the Globe company, Cleveland, as officers of that company are interested in the barge enterprise, and they are at an advantage in having built the first vessels. Some changes, suggested in the first trip, which was largely experimental, will be made in the new vessels. Engines of but about 120 horse power were used in the first steamer and this will probably be doubled in the new boat. An engraving showing the first steamer, the Alpha, and her tow in the Erie canal appears on this page. In making the canal passage, the method is to push one of the barges ahead of the steamer while four others are drawn astern.

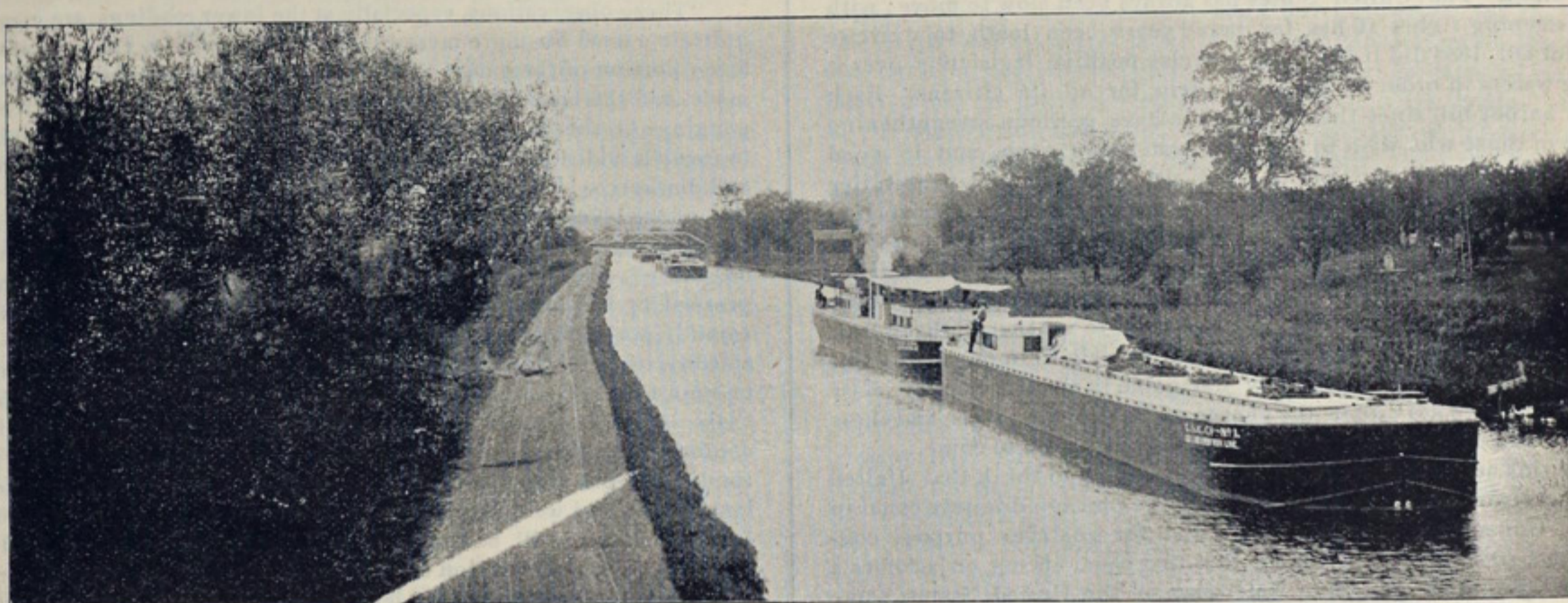
A Cornishman's Ability to Build a Pump.

In the city of Detroit there are three marine engine building concerns—the Dry Dock Engine Works, S. F. Hodge & Co. and the Frontier Iron Works—that are well known to everybody in the lake business, but it is probable that few vessel men, even among the old-timers, are acquainted with the story of the inception and development of these works. The late

engines almost exclusively. The firm of Hodge & Christie continued until 1871, when Mr. Christie retired, leaving Mr. Hodge sole proprietor of the business. Mr. Christie, in conjunction with Messrs. Philbrick and DeGraff, established the Frontier Iron Works, which has engaged largely in marine engine building and has built some of the most successful engines on the lakes. Mr. Hodge in 1875 and 1876 built the Riverside Iron Works upon water-side property which he had purchased some years previous. He afterwards added a lot west of the property originally purchased. The business was continued by him until 1883, when he turned it over to a joint stock company. He died in the spring of 1884, and the affairs of the concern have since been carried on successfully under the presidency of Harry S. Hodge, a further purchase of ground having been made and one of the most capacious and best appointed machine shops and foundry have been erected.

Test of Steamer Rappahannock.

Editor MARINE REVIEW: In your issue of August 15 you show a test of the power plant in the steamship Rappahannock, which is remarkable for the very low fuel consumption per I. H. P. as shown in that statement. I am not much in favor of sending schoolboys on board of steamers to teach old experienced, practical engineers what their engines can do. With the data given I am not able to check all of the figures, but I am satisfied of clerical errors in such items as per cent. of ashes, water evaporated per pound combustible, water per I. H. P. per hour, coal per ton mi'e, etc. However it is another matter to which I wish to direct your attention. The statement tells us that it was practically impossible to obtain any more than 21 inches of vacuum, but could they have gotten



LAKE ERIE—ERIE CANAL STEAMER ALPHA AND TOW OF FIVE BARGES.

Samuel F. Hodge, founder of the Riverside Iron Works, was born among the tin mines of Cornwall, England, and learned the trade of blacksmithing. Coming to this country he worked in various places, finally settling in Detroit, where he became superintendent of the smith's shop at the works of De Graff & Kendricks, later called the Detroit Locomotive Works and still later the Buhl Iron Works. Soon after the opening up of the copper deposits on the Keeweenaw peninsula an order was received by the Detroit firm from one of the mines for a quantity of machinery. The order was unintelligible to the officials in the office, when some one recollected that Mr. Hodge was raised in a mining country and would probably know what was wanted. He was accordingly summoned, and after reading the order declared that a Cornish pump was needed. Upon being asked if he could get one up he replied that he could, and he was given *carte blanche* to go ahead. He did so and the pump was made and shipped to its destination. It was entirely satisfactory and orders came thick and fast for mining pumps and other machinery peculiar to mining, with all of which Mr. Hodge was familiar. He made half yearly visits to the copper region, bringing down many orders. Afterwards he established himself in an office at the foot of First street, Detroit as a Lake Superior supply agent, taking contracts for machinery and giving the work to the few shops then existing in the city. This method of doing business not proving satisfactory, Mr. Hodge formed a partnership with Messrs. Cowie & Christie who held important positions at the locomotive works. The Michigan Iron Foundry, foot of Rivard street was leased from Wm. Barclay, and a business carried on under the firm name of Cowie, Hodge & Co. About the year 1866 or 1867 Mr. Cowie retired from the firm, and associating himself with Messrs. Ed. Jones, Robert Donaldson, John W. Smith and one or two others, the Dry Dock Engine Works was started and has since done a large business in the building of marine

24 inches of vacuum the increase in I. H. P. would be easily 125, which would not cost one cent, and the apparent fuel and water consumption would be reduced nearly 11 per cent.

The foregoing sentence is the part of the report that I have particularly in mind. I am somewhat surprised to see such a statement come from those who profess to teach engineers the theory if not the practice of the profession. In my education, both theoretical and practical, I have been led to believe that vacuum is not all clear gain in engineering practice. I think that generally on these waters there is no economy in carrying more than 22 or 23 inches of vacuum, on account of the excessive cooling of the low pressure cylinder and consequent condensation and also the low temperature of the feed water, as well as the extra labor on the air pump and consequent loss of power. There are cases on record where learned men have demonstrated that it was more economical to carry the vacuum as low as 18 inches, but that condition was probably caused by faulty design in the engine.

The average speed of 12.75 miles per hour is also remarkable for a wooden boat, especially so as judging from the very low fuel consumption the engine could not have been working up to its maximum capacity and the Rappahannock ought to be able to show a clean pair of heels to any other wooden boat on the lakes.

F. B. SMITH,
Engineer Steamer Joliet.

On the 30th inst., the firm of Fisher & Porter of Chicago, western representatives of the Bethlehem Iron Co., will be dissolved by mutual consent. Mr. Albert Fisher will retain the present office of the firm in the Monadnock block and will represent Wm. Todd & Co. of Youngstown on their high grade and heavy duty engines, rolling mill and blast furnace machinery. Mr. H. F. J. Porter will retain the agency of the Bethlehem Iron Co. and will move to the Marquette building.

Designers of Marine Engines.

Portraits contained in one of the supplements issued with this number of the REVIEW will probably be recognized by only a few of our readers, and yet the group represents quite fully the men who have had most to do with the great progress made in marine engineering on the lakes since big steel hulls have demanded the highest practice in marine engines and boilers. The names of the general manager of ship building plants on the lakes are all familiar to vessel owners, and they are in fact known personally to almost everybody in the vessel business, but their unassuming assistants in the drafting room, upon whose close attention to detail regarding every feature of machinery depends very largely the success or failure of a ship, are seldom heard of outside of the ship yard or the engine building plant. None of them are, however, complaining on this score. Their profession is dignified and their services should command liberal salaries.

Mr. I. G. Sowter, who is engaged with the Cleveland Ship Building Co., is probably the senior member of the group. Twenty-three years ago Mr. Sowter, who had formed the acquaintance of Frank E. Kirby, while engaged with John Roach, moved to Detroit to take a position with the late Samuel F. Hodge and he has been engaged with marine engine building concerns ever since. He is still as active as the youngest of men engaged in the same line of work and he is highly regarded by all of them, with whom he enjoys the most pleasant relations. Mr. Sowter was with the Hodge works for twelve years until 1884, when he went to the Dry Dock Engine Works, where he remained for nine years, before coming to Cleveland.

Walter Miller, who a few days ago resigned his position with the Globe Iron Works Co. of Cleveland and is about to depart on an extended European trip in search of rest, had been with the Globe company for fifteen years and took part in designing the first compound engines turned out of the works. Mr. Miller served an apprenticeship at the machinist trade. His early training was obtained in the Keystone Iron Works at Conneautville, Pa. He was engaged with engine building concerns in Bucyrus and Springfield, O., before coming to Cleveland, where he was fortunate, as a young man, to be favored with the good will and assistance of J. F. Holloway and W. H. Thompson, who were old heads and moving spirits in the famous Cuyahoga works. Mr. Miller was with the Globe company through all its time of progress, up to the completion of the twin-screw passenger steamers North West and North Land, which represent the very highest practice known to marine engineering throughout the world, as they are fitted with quadruple expansion engines and water tube boilers. Employes from different departments of the works, a few days ago, tendered him an expression of good will and appreciation of his relations toward them by calling on him at his home and presenting him with a cane and an elegant pair of field glasses. Upon his return from abroad, Mr. Miller expects to take up a residence in one of the eastern cities, very probably Philadelphia. He has disposed of an interest which he held in the Globe company and has been succeeded by William Cowles, who comes from Cramps' ship yard, Philadelphia.

Charles B. Calder and A. Geo. Mattsson, who have only recently been brought together in the employ of the Dry Dock Engine Works, Detroit, have been of one mind on important subjects in marine engineering for some time past, and their acquaintance in professional matters has resulted in a friendship that must prove advantageous to the concern with which they are now connected. Mr. Calder, on the one hand, has had a practical experience that peculiarly fits him for the position of superintendent of the Detroit shops. His entire life has been devoted to the profession. As a working engineer on lake vessels from boyhood he devoted a large part of his time to study of marine machinery. His ability as a young man was first recognized by the late Ira H. Owen of Chicago, although he has a great number of friends among vessel owners. Mr. Owen entrusted him with all matters pertaining to the machinery of vessels which he owned, and while the steamers Parks Foster and Ira H. Owen were being built in Cleveland, he represented the owners. This work brought him into close relations with the firm of M. A. Hanna & Co. of Cleveland, and Mr. L. C. Hanna of that firm, who is president of the Menominee and Mutual companies, operating lines of big steel freight vessels, made him shore engineer with full charge of all machinery in the lines. He put into effect a system of reports from engineers that gave the management full information regarding all matters pertaining to the operation of the ships, and his work ashore was so effective as to be copied largely by other lines. Frank E. Kirby and Gilbert N. McMillan of the Detroit Dry Dock Co. had by this time become acquainted with Mr. Calder through their relations with vessel owners who were interested in him and had watched his career. They offered him the position which he now holds with the Dry Dock Engine Works and he took it largely on account of the opportunities afforded for advancement in that large establishment. Mr. Mattsson leaves S. F. Hodge & Co. after a service of eleven years with the firm, during which time he has designed more than 100 marine engines. It will be readily

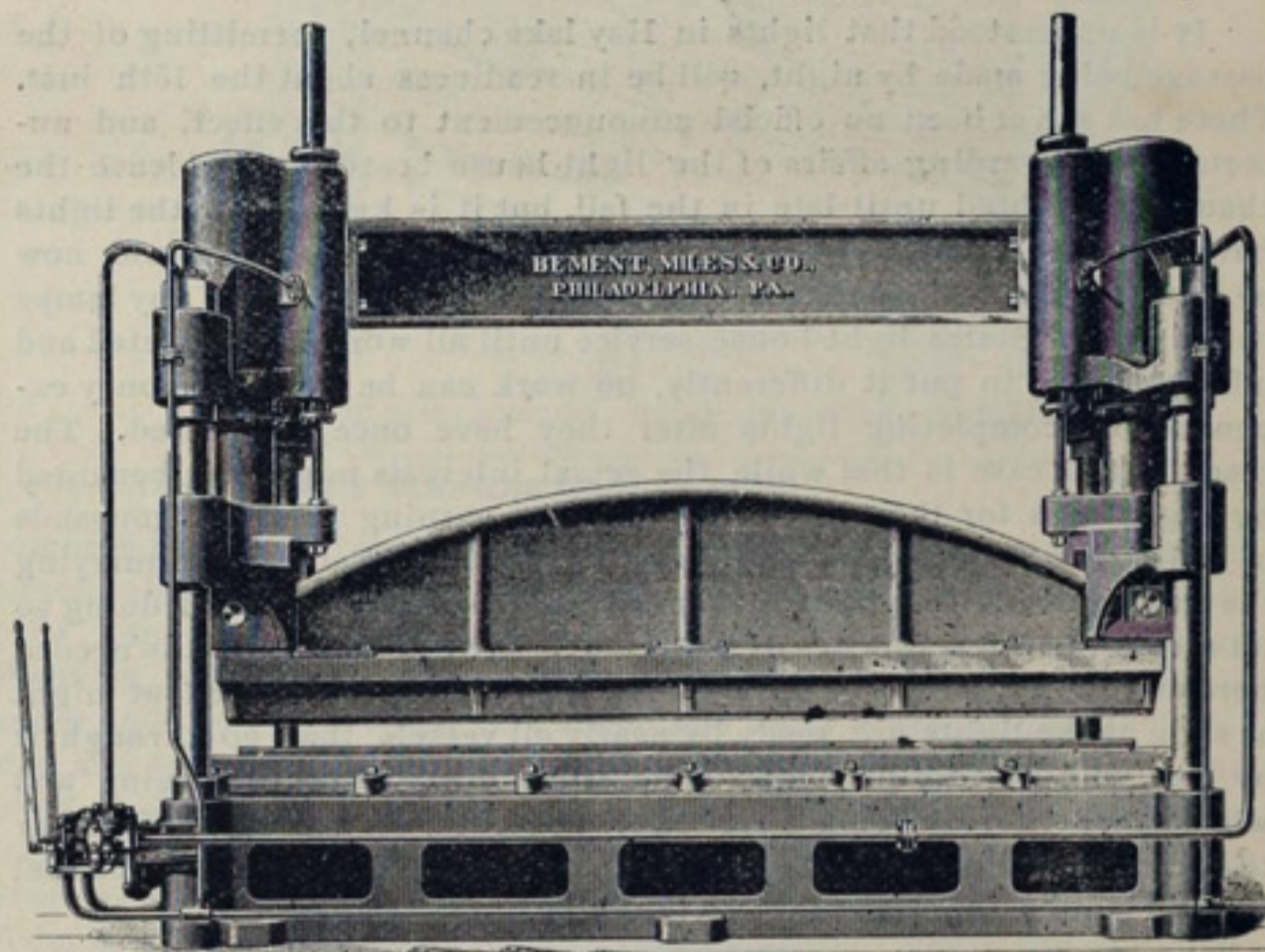
seen that the change is one of circumstances and not a disagreement between the parties concerned. Mr. Mattsson is a native of Sweden and received his early practical and technical training in that country.

Mr. H. Penton of S. F. Hodge & Co. the youngest of the group, furnishes an instance of what perseverance and application will accomplish. Beginning with a common school education, he served an apprenticeship as a machinist, afterwards taking up marine engineering, and has served as chief engineer of various lake and ocean steamers. He gave always his spare time to study, whether afloat or ashore, and so acquired a knowledge of mechanical drawing, having to be in all his own instructor. During two or three winters, Mr. Penton was associated with the late H. W. Granger, M. E., of Detroit, concerning whose abilities as a designing engineer he speaks in the warmest terms, and who he says was really the father of the modern lake marine engine. For the past five years he has been mechanical engineer to the Frontier Iron Works, whose work has become well known, not only on the whole chain of lakes but on both seaboard. Some of the more remarkable engines that have come from his hands are the W. H. Gilbert, which only a few weeks since was said to have beaten the famous Chemung; the Merida, till quite lately the largest steamer on the lakes; the Pacific coast steamship City of Everett; the Madagascar and Nicaragua, whose performance made quite a stir recently, and engines are very handsome; the famous whale-back towing steamer Pathfinder and the fast river steamer Unique. It is said of Mr. Penton and his engines that he has "been there" himself and that his engines are designed not only to do their work cheaply but to be as convenient and handy for the engineer as possible. He is thirty-one years of age and has lots of time yet before him.

Wm. L'E. Mahon, who succeeds Mr. Penton at the Frontier works, is a graduate of the Michigan university, but his college training in engineering was only preliminary to a practical experience that has extended over a number of years. He served an apprenticeship at the Dry Dock Engine Works and was employed in the drafting department of that establishment before being first engaged at the Frontier works. He is now employed a second time by the Frontier company. He was engaged in the meantime with the Marinette Iron Works and as superintending engineer with the American Steel Barge Co.

Channel System Flanging Machine.

The following illustration shows a universal hydraulic flanging machine, built by Bement, Miles & Co., Philadelphia. As may be noticed in the illustration, there is a tie-beam between the cylinders. It is especially adapted for ship-building purposes, and was designed by the builders. It will be found available for keels, garboard, strakes, sponsons, deck plates and miscellaneous plate work up to 3 inches thickness. Clear space between bolts is 16 feet long by 6 feet wide, and spaces



can be modified when required. The cylinders are 14 inches diameter by 30 inches stroke, giving a net pressure of 200 tons at 1500 pounds per square inch. Both ends of beam may be operated together, or either end independently. Pull-back plungers for return of clamping beam are always open to accumulator. These machines are in use at the works of Wm. Cramp & Sons, the Newport News Ship Building and Dry Dock Co., and the Maryland Steel Co., Sparrow's Point, Md. All important machinery in the Dry Dock Engine Works, Detroit, was built by Bement, Miles & Co.

COPIES OF THE LATEST CHARTS OF GEORGIAN BAY HARBORS MAY BE HAD FROM THE MARINE REVIEW, 516 PERRY-PAYNE BUILDING.



DEVOTED TO THE LAKE MARINE AND KINDRED INTERESTS.

Published every Thursday at No. 516 Perry-Payne building, Cleveland, O

SUBSCRIPTION—\$2.00 per year in advance. Single copies 10 cents each. Convenient binders sent, post paid, 75 cents. Advertising rates on application.

The books of the United States treasury department contain the names of 3,341 vessels, of 1,227,400.72 gross tons register in the lake trade. The number of steam vessels of 1,000 gross tons and over that amount on the lakes on June 30, 1894, was 359 and their aggregate gross tonnage 634,467.84; the number of vessels of this class owned in all other parts of the country on the same date was 316 and their tonnage 642,642.50, so that half of the best steamships in all the United States are owned on the lakes. The classification of the entire lake fleet on June 30, 1894, was as follows:

Class.	Number.	Gross Tonnage.
Steam vessels.....	1,731	843,239.65
Sailing vessels.....	1,139	302,985.31
Canal boats.....	386	41,961.25
Barges.....	85	39,214.51
Total.....	3,341	1,227,400.72

The gross registered tonnage of vessels built on the lakes during the past five years, according to the reports of the United States commissioner of navigation, is as follows:

Year ending June 30,	Number.	Net Tonnage.
1890.....	218	108,515.00
" " " 1891.....	204	111,856.45
" " " 1892.....	169	45,168.98
" " " 1893.....	175	99,271.24
" " " 1894.....	106	41,984.61
Total.....	872	406,976.28

ST. MARY'S FALLS AND SUEZ CANAL TRAFFIC.
(From Official Reports of Canal Officers.)

	St. Mary's Falls Canal.			Suez Canal.		
	1894.	1893.	1892.	1894.	1893.	1892.
No. vessel pass'ges	14,491	12,008	12,580	3,352	3,341	3,559
T'n'ge, net registd	13,110,366	9,849,754	10,647,203	8,039,106	7,659,068	7,712,028
Days of Navigat'n	234	219	223	365	365	365

Entered at Cleveland Post Office as Second-class Mail Matter.

It is understood that lights in Hay lake channel, permitting of the passage being made by night, will be in readiness about the 15th inst. There has as yet been no official announcement to this effect, and uncertainties regarding affairs of the light-house board may yet leave the channel unlighted until late in the fall, but it is known that the lights have all been practically complete for some time past, and would now be in use, but for a regulation that prohibits the lighting of any lamps in the United States light-house service until all work is completed and bills paid; or, to put it differently, no work can be done or money expended in completing lights after they have once been used. The result in this case is that while the vessel interests might be benefited by night runs for the next three months, earning thereby thousands of dollars for themselves and assisting general business by hurrying the movement of freight of all kinds, they are prevented from doing so on account of a few touches of paint and a little polishing that is needed here and there. There is no doubt of the channel being used at night as soon as the lights are ready by nearly all vessels that go through it by day, and at this particular time, when every wheel is turning and when every effort is being strained to move ore, coal, grain and lumber to the extreme limits of production, the delay in lighting this channel is not a matter complimentary to the light-house board.

ALTHOUGH THE price of material entering into the construction of steel ships has been almost doubled of late, the addition to prices of new ships from this source is not of sufficient importance to be taken largely into account in the matter of placing orders with ship builders. It is not, as some might suppose, a particular drawback to active operations in the ship yards. Labor is a far more important item in ship building. Immediate advantages in carrying charges offset the higher cost of material many times over, but with the ship owner who is in business through good and bad years the policy of building at this time, when all costs are much higher than in times of depression, is another matter.

ALTHOUGH A coroner's jury, passing upon the drowning of a fireman, acquitted the tug captains whose boats collided in Duluth harbor while fighting for a tow several days ago, the United States steamboat inspectors

have revoked the licenses of both men. This is good news, and the local inspectors should be backed up by the authorities at Washington. The conclusion of the coroner's jury was undoubtedly a whitewash. The tug captains were certainly engaged in the "bulling" practice that is only too common of late.

FROM PRESENT indications the troublesome feature of next year's lake trade as a whole will not be the amount of freight to be moved nor the vessels to carry it. Railways will furnish the drawbacks. They are away behind in equipment and it would seem impossible for them to catch up.

From Various Sources.

J. R. Irwin, Fairport vessel owner and dock manager, who died recently, carried life insurance aggregating about \$100,000, a large portion of which was written within a year previous to his death. Quite a few of the vessel owners carry large lines of life insurance.

The 400-foot steamer to be built by the Cleveland Ship Building Co. for A. B. Wolvin and others will be constructed on the channel system, described in this issue, as also the steamer to be built at South Chicago for C. W. Elphicke & Co. The boat to be built by the Cleveland company will also be under the inspection of the United States Standard Register of Shipping.

President Goodrich, of the Goodrich Transportation Company, Chicago, has J. B. Woods, formerly employed with the Globe Iron Works Co., Cleveland, engaged on plans for the wooden passenger steamer that has been in contemplation for some time past, and this action would seem to indicate that it is now the intention to build the boat at Manitowoc, where other wooden boats of the Goodrich line have been built. If such is the case, the contract for machinery will very probably go to Charles Elmes, of Chicago.

Navy engineers who recently made a trip on one of the Northern line passenger ships, with a view to observing the operation of the Belleville boilers and quadruple expansion engines, were enabled to collect little data excepting for a run of about 16 hours on Lake Superior. They were, however, very favorably impressed with the ship's engines. On the run up Lake Superior from Whitefish to Keweenaw the ship encountered a head wind of about 28 miles velocity, and yet the difference in speed on the return trip over the same stretch of water with no wind was of little importance. This is considered remarkable when the amount of top hamper carried by the ship is taken into account.

It is probable that the big freighter to be built by the Cleveland Ship Building Co. for A. B. Wolvin and others will be controlled entirely by the Zenith Transit Co., of Duluth, as it was the intention to have the stock owned by the same parties that control the steamer Zenith City. The building of the steamers Gilbert, Kearsarge, Zenith City, Victory and this last vessel is understood to involve a system of bonds, preferred and common stock, etc., that is all new to vessel owners who have for years done business on practically a cash basis. Of course the ship builder gets his money as in all other cases, and this system of financing is in accordance with modern methods, but it is not altogether suited to the vessel business.

The whaleback passenger steamer Christopher Columbus goes into winter quarters at West Superior after making an excursion trip out of Duluth and Superior, that was planned mainly for the purpose of defraying the expense of taking her to the head of the lakes. With the Goodrich liner Virginia and Columbus engaged in excursion business out of Chicago at low rates again during the past season, money returns in both cases were probably far below what they should be. There was talk a short time ago of the Columbus being converted into a freight carrier, but Capt. McDougall, who was in Cleveland a few days ago, said he was not aware of anything being done, although the whaleback was constructed so as to admit of her conversion into a freight carrier if it ever became necessary to make the change.

Stockless anchors are now as popular on the lakes as they are in ocean service. None of the big new ships are sent out without them. When Assistant General Manager F. P. Gordon, of the Northern Steamship Co., found it impossible, on account of certain hindrances in the bow of the North West, to fit anchors of this type to the big passenger ship, he said he would have them in the second boat at all hazards, but the difficulties were unsurmountable. The Chicago Ship Building Co. made the neatest kind of a job in fitting stockless anchors to the Victory and Zenith City. Anchors of this kind can be dropped by simply pulling a chain on the fore-castle deck, but in the Zenith City Manager Wolvin has proposed going a step further, and at last accounts was working on a "trip," which was to be so arranged that the officer of the deck could drop anchor by simply stamping his foot on an iron bar coming up through the deck.

Steamers Victory and Zenith City.

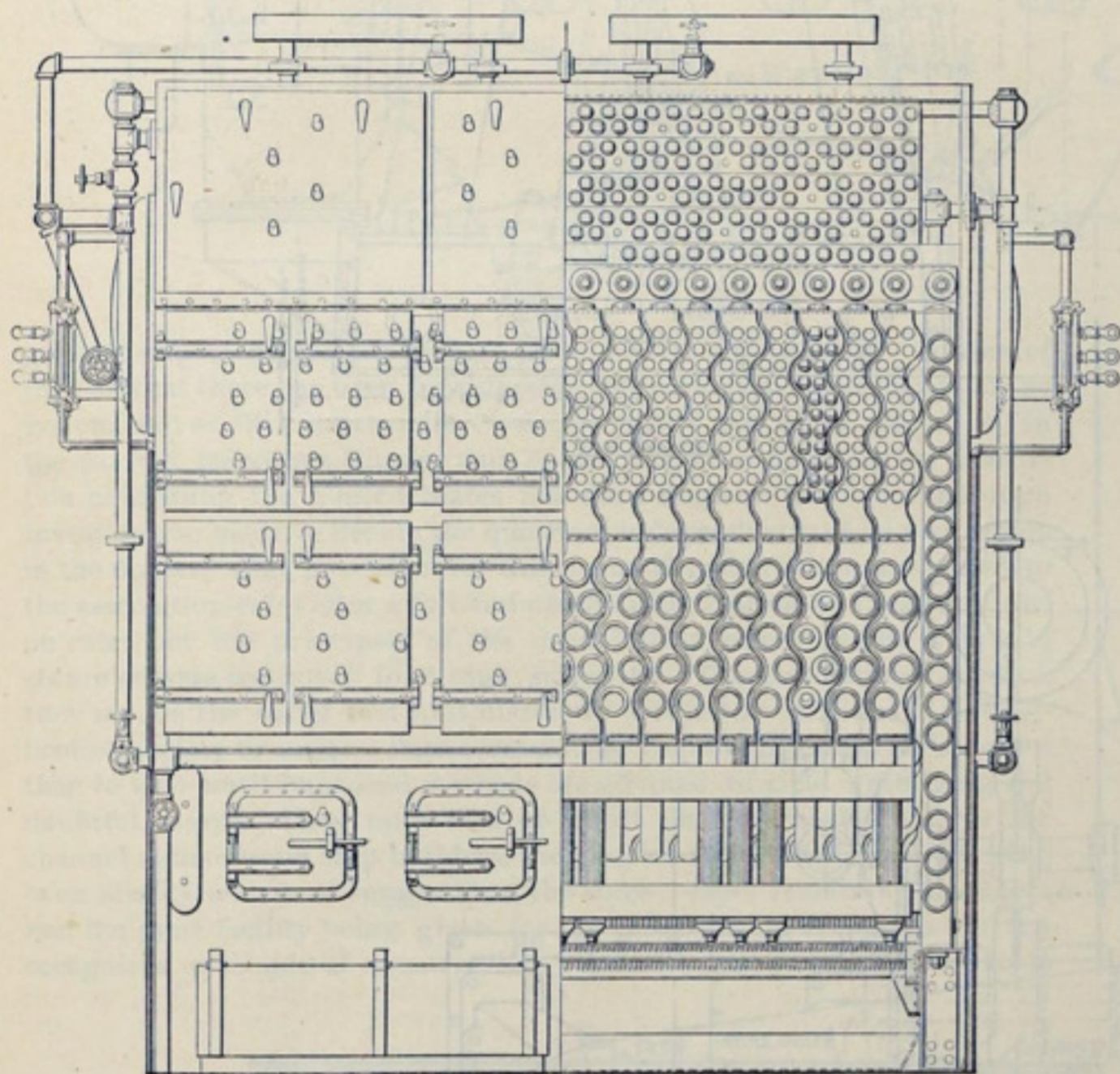
Illustrations of the steamers Victory and Zenith City, two ships that are the forerunners of 400-foot lake freighters, are presented in supplements accompanying this issue of the REVIEW. The engraving of the Victory is from a photograph, and her great length is indicated by the spars and outline of a wooden freight steamer that was passing beside her in the Detroit river when the photograph was taken. The photochromotype (color print) of the Zenith City, which is not as yet in commission, is from a painting made by George A. Coffin of Chicago.

As these steamers represent the latest practice in the construction of coarse freight carriers on the lakes, and as they will probably be followed by as many as fifteen ships of their kind, entering into the iron ore, coal and grain trades next season, a description of one of them, the Zenith City, controlled by Mr. A. B. Wolvin of Duluth, will prove interesting. H. G. Dalton, of the firm of Pickands, Mather & Co., Cleveland, is managing owner of the Victory, and the only material difference in the two boats is that the Zenith City is fitted with Babcock & Wilcox water tube boilers, while the Victory has Scotch boilers of the kind common to lake steamers. The Victory has a water bottom of $5\frac{1}{2}$ feet depth, against 5 feet in the Zenith City, and there are a few other differences in minor details, but hulls and engines are practically duplicates. It has already been stated that the bureau of steam engineering, navy department, will take advantage of the adoption of water tube boilers in the Zenith City, to

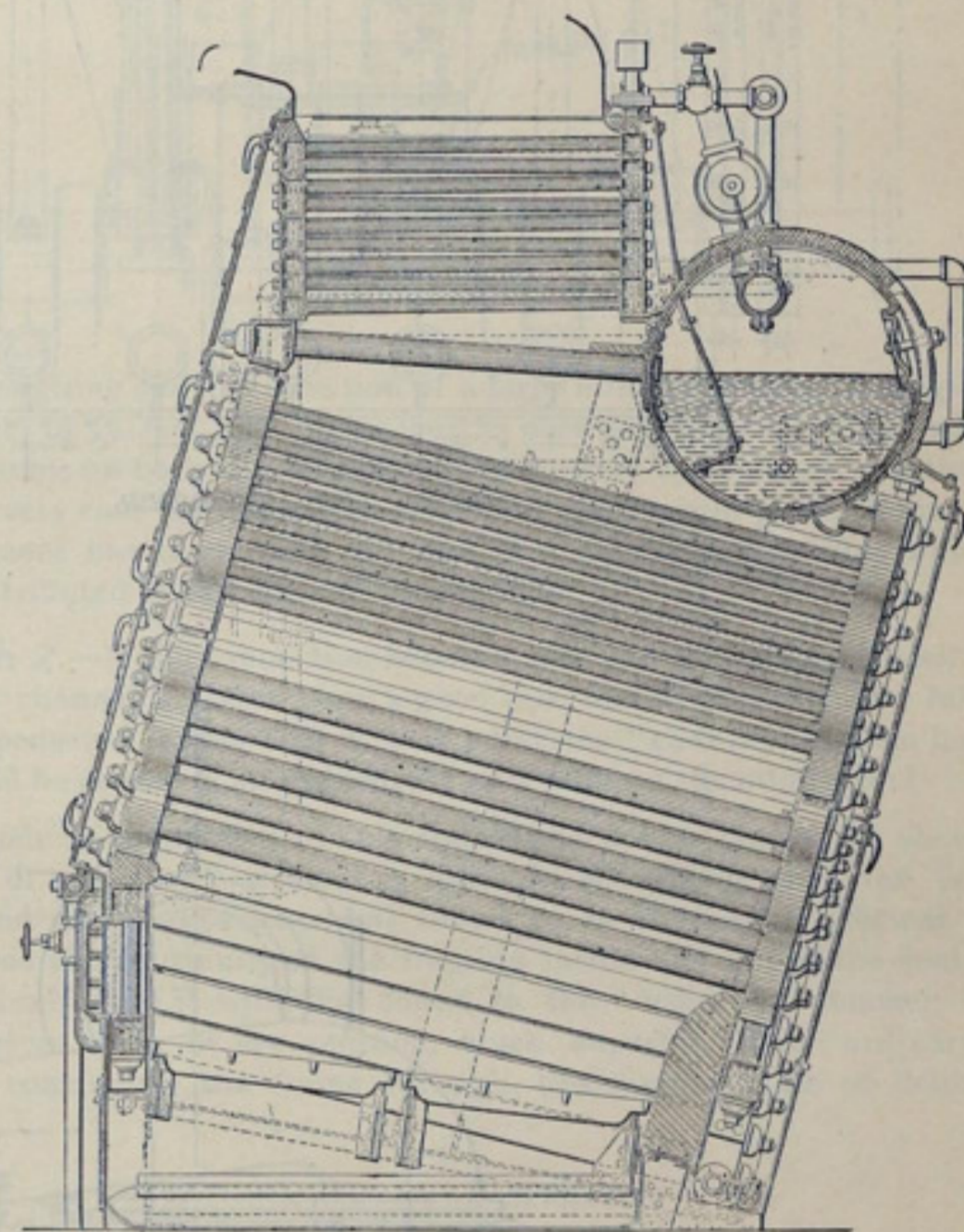
ceedingly stiff side to the ship. On each side of the center keelson there are four longitudinals, and all of them are carried down to the bottom plating by intercostal chocks the same depth as the floors. The bottom plating is, therefore, very heavily supported and braced. Steel shifting boards 8 feet wide are worked under the spar deck on the stanchions, and carried across hatches by swinging boards, also of steel.

The engine, which in a duplicate of that in the steamer Kearsarge, was built by the Cleveland Ship Building Co. and is of triple expansion type with cylinders 22, 38 and 63 inches diameter and 40 inches stroke. There are two Babcock & Wilcox water tube boilers of marine type, which are placed facing each other, immediately forward of the engines, with fire room between. They have 6,000 square feet of heating surface and 144 square feet of grate. Among auxiliary machinery are two large ballast pumps made by the Laidlaw Dunn-Gordon Co., which are located in the lower engine room; steam windlass and capstan of the American Ship Windlass Company's make; a Williamson steam steerer in the engine room, and a deck hoister made by the Chase Machine Co. of Cleveland. The electric lighting plant consists of two 125 light direct connected generating sets made by the Fisher company of Detroit. There are also four arc lights.

Open hearth steel forgings and straight charcoal iron boiler tubes are used entirely in the Babcock & Wilcox boiler, which consists essentially of two banks of tubes placed at an angle of 15 degrees from the horizontal and separated by a combustion chamber, the lower bank being



DESIGN OF BABCOCK & WILCOX WATER TUBE BOILERS FOR LAKE FREIGHT STEAMER ZENITH CITY.

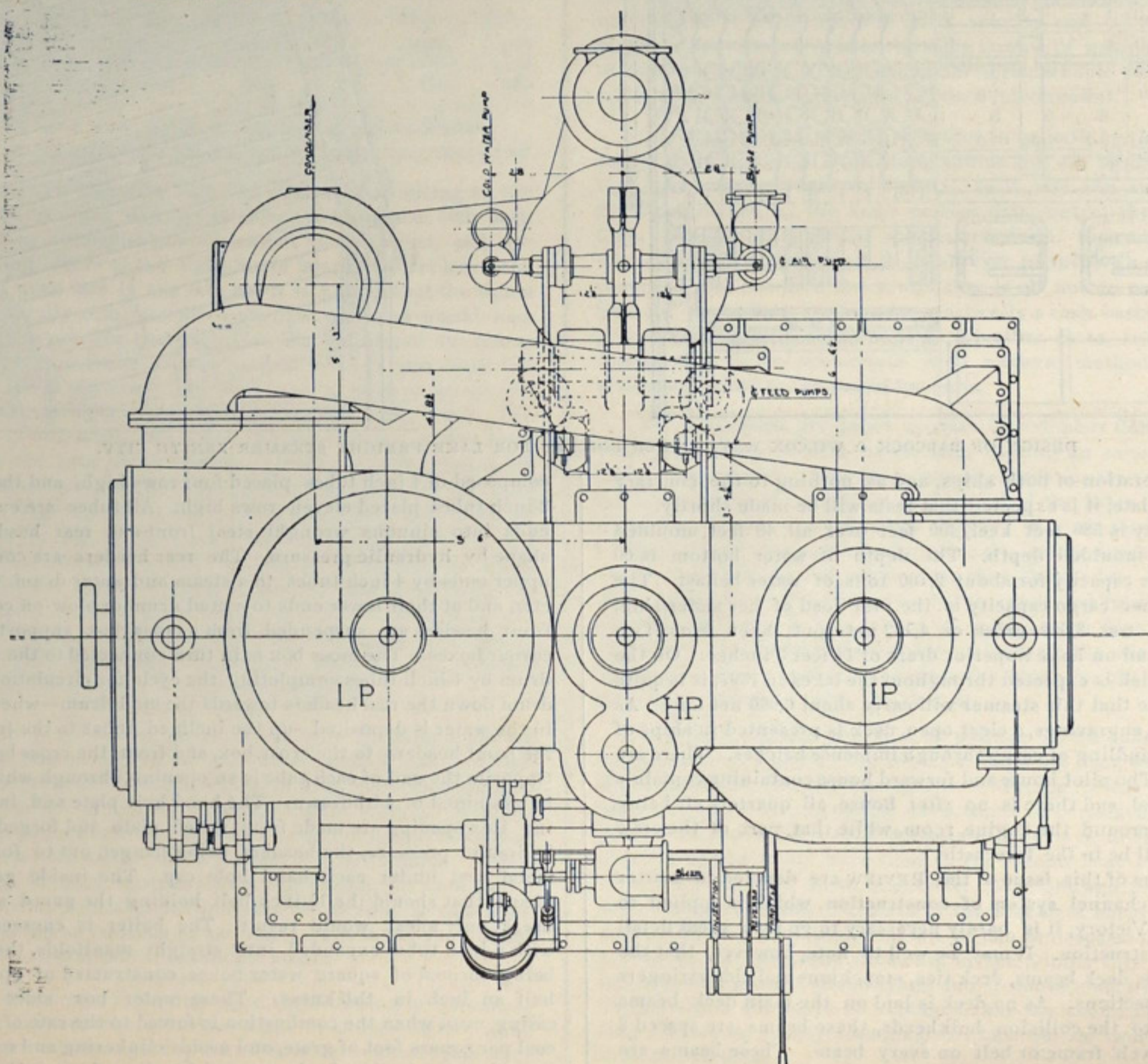
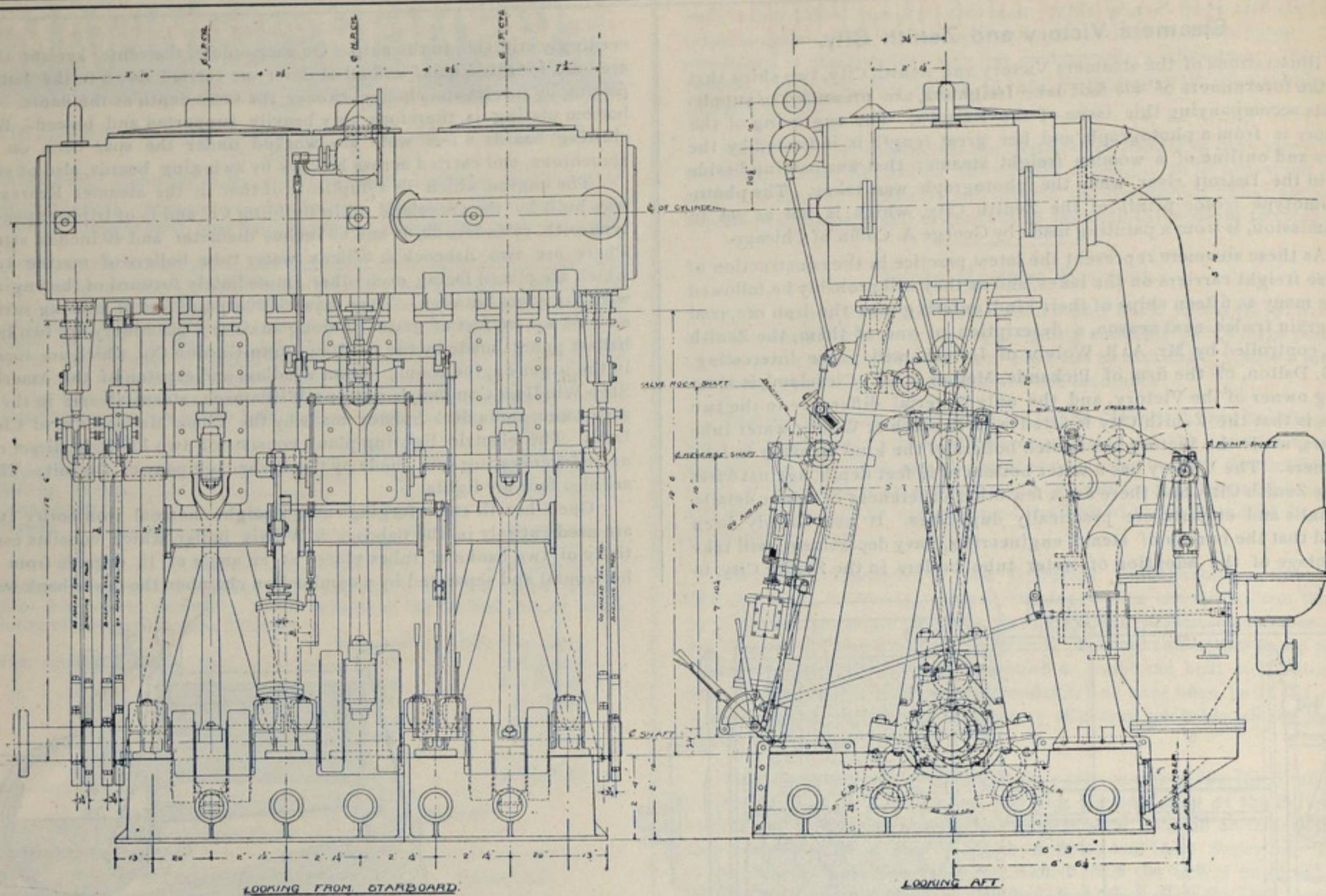


observe of the operation of both ships, and as nothing to the contrary has been heard of late, it is expected that tests will be made shortly.

The Zenith City is 380 feet keel, 400 feet over all, 48 feet moulded beam, and 28 feet moulded depth. The depth of water bottom is 60 inches, which gives capacity for about 2,100 tons of water ballast. The best indication of her cargo capacity is the first load of her sister-ship, the Victory, which was 3,689 gross or 4,132 net tons, taken from Two Harbors to Cleveland on Lake Superior draft of 14 feet 3 inches. On the draft of 18 feet, which is expected throughout the lakes in 1897, it is quite reasonable to figure that this steamer will carry about 6,000 net tons. As will be seen by the engravings, a clear open deck is presented in ships of this kind for the handling of cargo through immense hatches. There are three pole spars. The pilot house and forward house containing captain's quarters are of steel, and there is no after house, all quarters aft being on the main deck, around the engine room, while that part of the crew located forward will be in the forecabin.

As several pages of this issue of the REVIEW are devoted to matter pertaining to the channel system of construction, which is applied to this ship and the Victory, it is hardly necessary to go into great detail regarding her construction. It may be well to note, however, that the floors, frames, belts, deck beams, deck ties, stanchions and side stringers are all of channel sections. As no deck is laid on the main deck beams from the bunker to the collision bulkheads, these beams are spaced 8 feet apart, with a web frame or belt on every beam. These beams are bracketed both above and below the stringer to the belts, and there is a side stringer between them and the spar deck beams, in addition to the usual side stringer in hold, both carried out to the shell, making an ex-

composed of 4-inch tubes placed four rows high, and the upper band of 2-inch tubes placed eleven rows high. All tubes are expanded at their ends into sinuous wrought steel front and rear headers, forged into shape by hydraulic pressure. The rear headers are connected at their upper ends by 4-inch tubes to a steam and water drum 42 inches diameter, and at their lower ends to a mud drum or blow-off connection. The front headers are suspended from a cross box supported by two front corner boxes. The cross box is in turn connected to the steam and water drum by 4-inch tubes completing the cycle for circulation, i. e., from the drum down the rear headers towards the mud drum—where any sediment in the water is deposited—up the inclined tubes to the front headers, up the front headers to the cross box, and from the cross box to the drum. Opposite the end of each tube is an opening, through which the tube may be examined or withdrawn. The hand hole plate and inside guard closing this opening are made from rolled plate and forged into shape by hydraulic pressure, the headers being flanged out to form the metal to metal seat under each hand hole cap. The inside guard is of such shape that should the $1\frac{1}{2}$ -inch bolt holding the guard and cap in place break, only a leak would result. The boiler is encased on the sides with 4-inch tubes expanded into straight manifolds, the furnace sides being formed of square water boxes constructed of open hearth steel half an inch in thickness. These water box sides insure a cool casing, even when the combustion is forced to the rate of sixty pounds of coal per square foot of grate, and avoids clinkering and repairs. Against the side tubes is placed asbestos and 2 inches of magnesia block covering the whole being held into place by sheet iron plates braced with angle irons and bolted to the foundations.



Plans of Triple Expansion Engines, Steamer Zenith City.—Built by Cleveland Ship Building Co.

CHANNEL SYSTEM OF CONSTRUCTION.

A Comparison With Other Methods—Exhaustive Report from Geo. R. McDermott, Professor of Naval Architecture at Cornell University, on Two Systems of Construction Proposed for Vessels Engaged in Service on the Lakes—Letters on the Subject from Lake and Coast Builders.

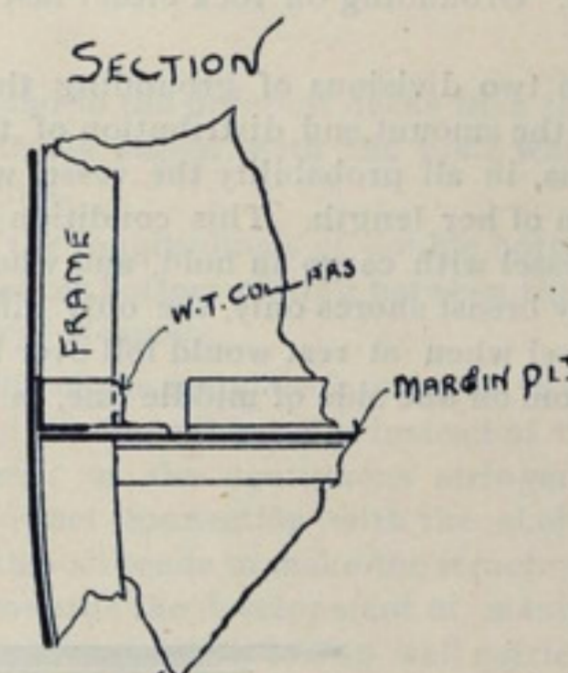
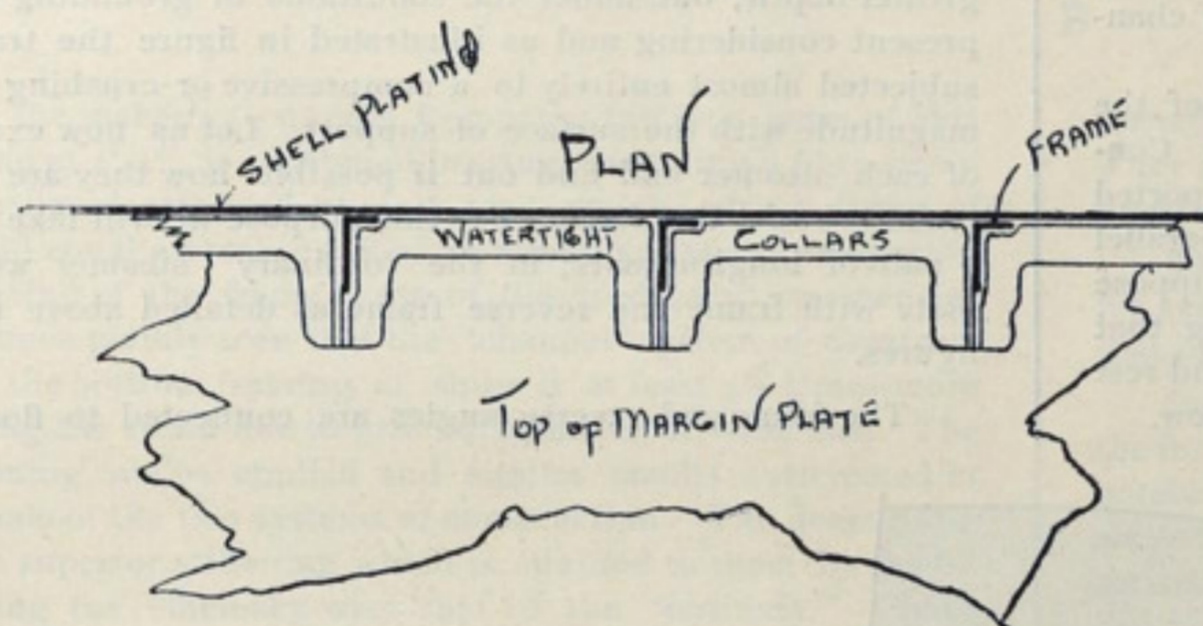
The channel system of construction, introduced by Mr. Sinclair Stuart of the United States Standard Register of Shipping, New York, has of late been applied to so many lake vessels, all of them of the very largest type of freight steamers, that the question of merit attending its adoption is of the

—will be referred to as the "ordinary," while the vessel having channel bars for frames, beams, etc., will be referred to as the "channel" steamer. Appended to the report are the scantling sections of the "ordinary" and "channel" steamers as submitted to Prof. McDermott for examination, and also a section showing modification which he proposes for the "channel" steamer, but it has not been thought necessary to reproduce these. They will be found in the supplement to the register, which will contain the report.

REPORT ON TWO SYSTEMS OF CONSTRUCTION.

Question 1.—Is there any objection to cutting the frame of a ship at the tank top?

There can be no objection on either theoretical or practical grounds to cutting the frame of any vessel at the tank top, providing that efficient and direct connection is made to the margin plate, by means of bracket plates and double angles fitted to the frame within and above double bottom. It is almost the universal practice, both at home and abroad, to cut the frame at the tank top. In my own experience I have had to do

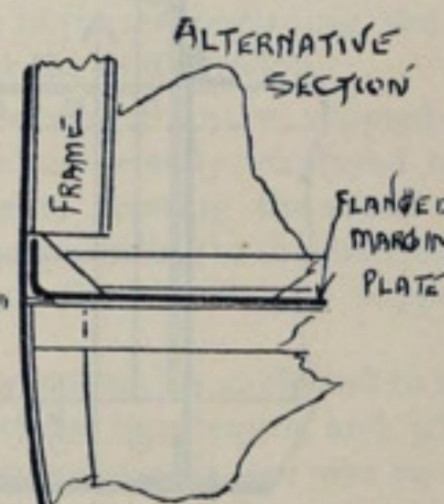
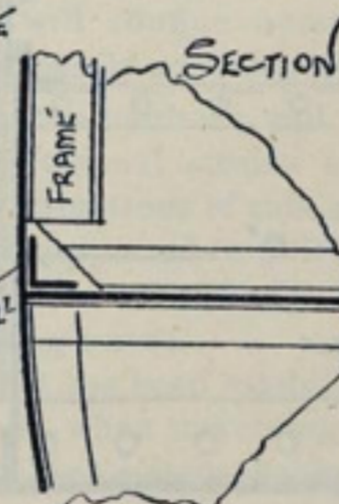
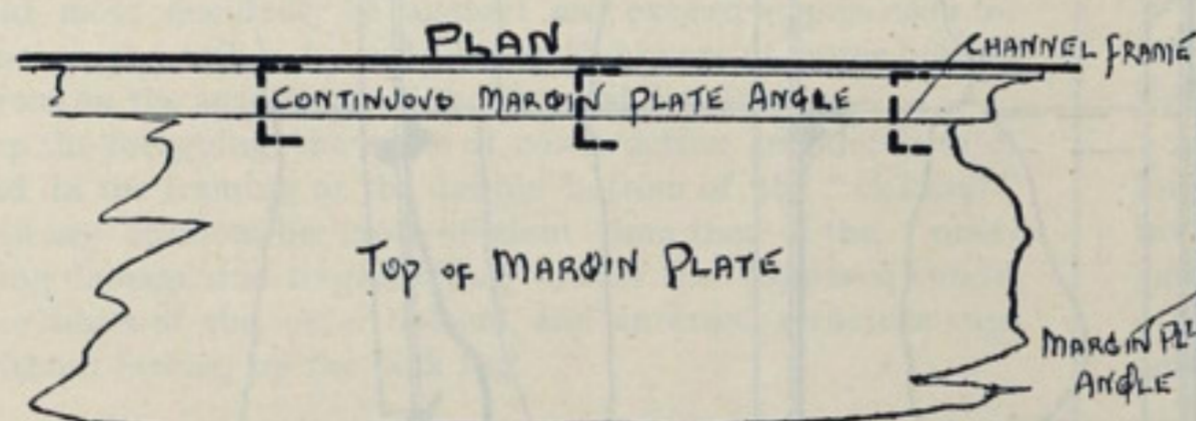


greatest importance to ship owners, underwriters and builders. In view of the fact that there has been considerable controversy over the merits of the system, and as this construction was practically new when carried out in the 400-foot freighters Victory and Zenith City, the classification association publishing the United States Standard Register has had a thorough investigation made to decide the question, independently of its own action in the matter. The provision for this form of construction was added to the association rules after a full and careful examination by the committee on rules, but the principals of the organization have thought it best to secure outside testimony from high authority. The association has acted, they say, on the belief that it is distinctly within the province of a classification society to suggest improvements in ship building methods, rather than to wait until improved methods are adopted to yield a grudging and doubtful assent. They note that no effort has been made to force the channel system upon ship builders, the provisions for such system having been simply added as suggestions, the rules proper remaining as before and the same facility being given for the classification of vessels on any recognized principle of construction. Attention is directed, however, to

with the designing and construction of a large number of vessels, ranging from 160 feet to 530 feet long (three-fourths over 400 feet long), fitted with double bottoms on both the cellular and MacIntyre systems of construction. In every case the frame was severed at the margin plate, and in no single instance has there been any sign of weakness or straining which could be attributed to this form of construction.

Question 2.—Is the connection between side and bottom, as shown in the "channel" system plan, a good one, and is the cut frame fully compensated for, so that at this point the "channel" system boat would be as strong and seaworthy as if built on the other plan?

The mode of connection of side framing to double bottom as shown in section of "channel" steamer is quite in accordance with the best practice, and which experience has shown to be thoroughly efficient in making good the continuity of the framing inside and out of the double bottom. Comparing it with that found in the "ordinary" steamer, in many respects it is, in my opinion, much superior. The "ordinary" system of continuing the frame through the margin plate of double



the vessels that have been built and are being built under the system, and to the very favorable expressions of opinion contained in letters from Messrs. Babcock, Gaskin, and other builders on the lakes and coast.

REPORT OF PROF. GEO. R. McDERMOTT.

COMPARISON OF TWO SYSTEMS OF CONSTRUCTION WITH SPECIAL REFERENCE TO LAKE SERVICE.

The most important information on the subject submitted for the judgment of the ship building and ship owning interests is the report that follows from Geo. R. McDermott, professor of naval architecture at Cornell University. In making the comparison, Prof. McDermott notes that the steamer having the frame formed of two angles—frame and reverse frame

bottom necessitates the working of water-tight collars or staple irons around frames in order to preserve the water-tightness of the double bottom. See sketches. Whereas, in the "channel" system the water-tightness of double bottom is effected at this point by the margin plate angle or flange of margin plate, as shown in alternate sketch, running continuous and unbroken for the full length of double bottom.

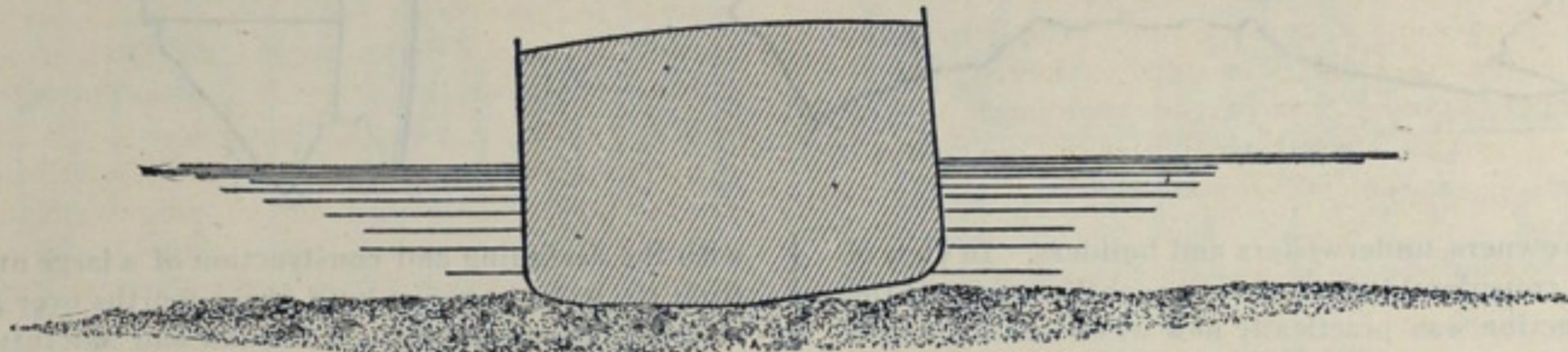
The superiority of the latter plan over that of the "ordinary" is, I think, self-evident; the fitting of water-tight collars around the continuous frame is both expensive and troublesome, and with the greatest amount of care taken it is never as satisfactory as the continuous angle or flange margin plate. Again, in view of the violent jars to which the bottom structure is subjected from the loading of ore, as also those due to grounding and other causes peculiar to the trade, I am decidedly of the opinion that the continuous angle or margin plate flange would perform

its work much more efficiently than the water-tight collars which are a necessary adjunct of the system of framing adopted in the "ordinary" steamer.

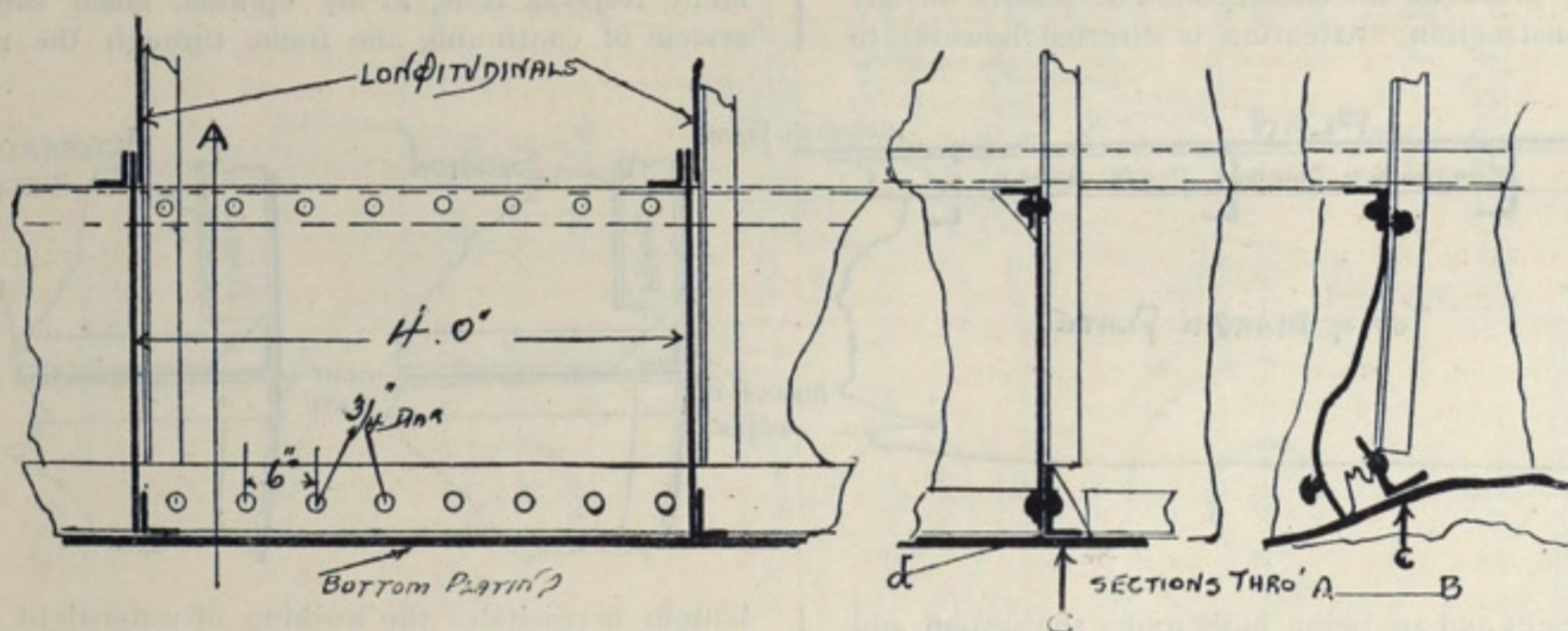
Question 3.—It is desirable that boats in the lake service should be so constructed, since they take the ground frequently, that when the stranding is severe enough to do damage, it be confined to the bottom without forcing up the tank top? In boats built on the "ordinary" plan this damage is usually confined to the bottom. Would this be the case, in your opinion, if the boats were built on the "channel" system? This stranding occurs when the boat is loaded and the cargo is pressing down on the tank top, and it usually occurs in the rivers, where the water is still and the boat does no pounding after grounding. These boats are supposed to carry about 4,000 gross tons on say 14' 9", and nearly 6,000 gross tons when loaded to 20'.

In order that this question may be satisfactorily answered, it is desirable that the conditions of grounding be divided up into two classes or divisions: 1st. Grounding in channels where the bottom is uniformly flat or nearly so. 2nd. Grounding on rock either fast in bottom of channel or adrift.

In either of these two divisions of grounding the intensity of the strains depends upon the amount and distribution of the supports. Considering the first class, in all probability the vessel would be supported for the greater portion of her length. This condition is almost a parallel one with docking a vessel with cargo in hold, and where we may suppose she is held upright by breast shores only, the only difference being, that in grounding, the vessel when at rest would loll over to one side and rest on the flat of her bottom on one side of middle line, as in sketch below.



In either case, both longitudinal and transverse straining actions are set up, the whole of the weight of the vessel and cargo is transmitted through the bottom of the vessel to the ground or keel blocks, part of the upward thrust or reaction (from ground or blocks) is employed in bending the bottom and sides of vessel, the remainder being transmitted through the pillars to the beams of the different decks, which will bend under this force to the same extent as the bottom, providing, of course, that the pillars or stanchions do not buckle or collapse, in which case the bottom would have this additional force to contend with, at the same time the sides of the vessel will sink down until the different parts of the structure of the vessel as a whole are sufficiently strained or brought into play to



insure equilibrium between the opposite forces. The smaller the area of bottom upon which the vessel rests and the nearer the amidships the greater will be the resultant strain; the general tendency, however, as stated above, will be to force up the bottom, and, so far as longitudinal bending is concerned, whether the grounding is concentrated over a large portion of the length or otherwise, very little, and probably in the majority of cases, no signs of straining will be observed on the sheer strake or top sides, but evidence will not be wanting around the bilges and bottom. If the grounding is over a large part of the vessel's length the longitudinals or keelsons of any vessel will contribute very little towards the longitudinal strength as they will simply move up with the bottom; they, however, assist the floors in resisting the transverse strains and

stiffening the outside plating, assisting thereby to develop its ultimate strength. Should, however, the grounding be confined to a relatively small portion of the length, the longitudinals, more especially the center longitudinal or keelson, become important in resisting the action of the longitudinal bending forces. Coming now to the comparison of the bottom of the "ordinary" and "channel" steamers: In resisting strains of the nature of the first division of grounding, the outside bottom plating of the "channel" steamer is stronger by about $3\frac{3}{4}$ per cent. over that of the "ordinary"; the weight per square foot being 27 pounds and $26\frac{1}{2}$ pounds respectively. Taking the transverse framing next in order, in the "ordinary" steamer we have a floor plate $29'' \times \frac{1}{2}''$ connected to a frame angle $6'' \times 3\frac{1}{2}'' \times \frac{7}{16}''$ and with reverse bar on upper edge $4'' \times 3'' \times \frac{7}{16}''$, as against a channel bar $15'' \times 3.4'' \times 3.4'' \times 33$ pounds in the "channel" steamer, the frames in both steamers extending from the center line on each side of the ship to the bilges, where they are connected to the bilge bracket plate. If we make the comparison between the two styles of transverse frames, treating each as a beam with a given equal load, the "ordinary" compound frame is undoubtedly the stronger owing to its greater depth; but, under the conditions of grounding which we are at present considering and as illustrated in figure the transverse frame is subjected almost entirely to a compressive or crushing force varying in magnitude with the surface of support. Let us now examine the frame of each steamer and find out if possible how they are individually prepared to resist this force. For this purpose we will take a length between a pair of longitudinals; in the "ordinary" steamer we have the floor plate with frame and reverse frame as detailed above and as shown in figures.

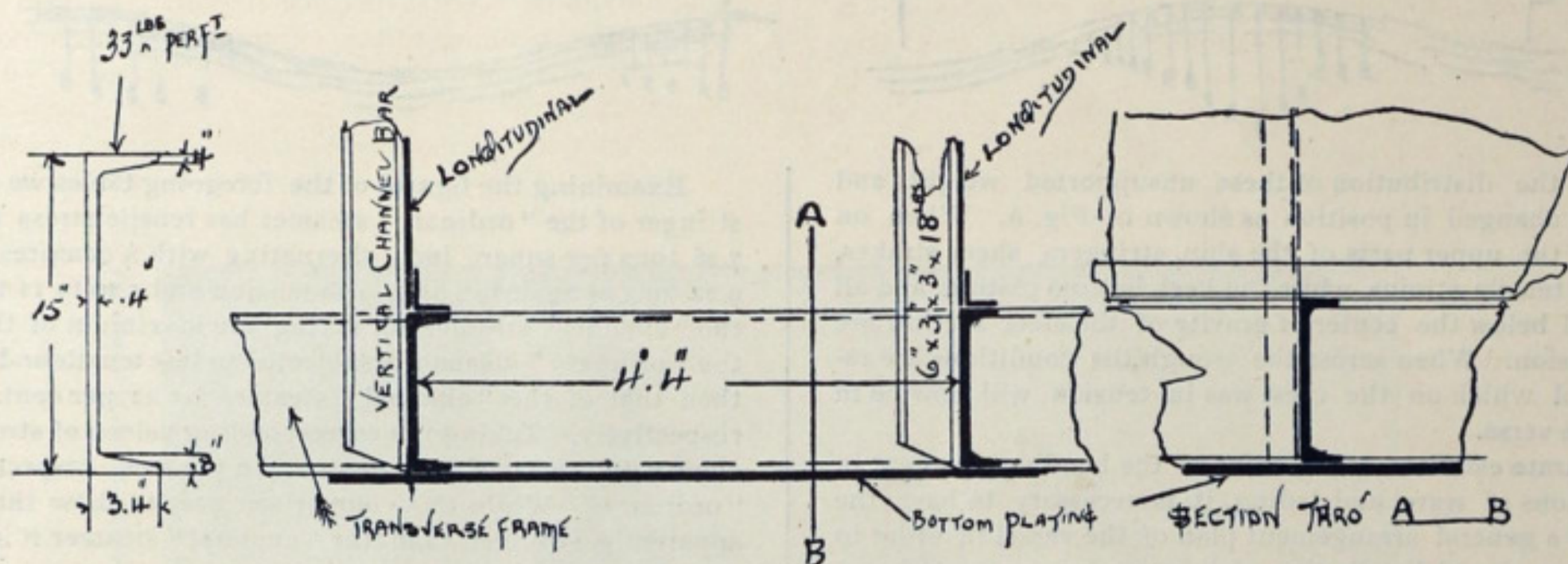
The frame and reverse angles are connected to floor plate with $\frac{3}{4}''$

rivets spaced 8 diameters= $6''$ apart. It will perhaps be unnecessary for me to explain that in order to insure close contact between the frame angle and outside plating, the floor plates are sheared or cut to a size and connected to frame so that the lower edge is up from the heel of the angle a distance varying from $\frac{1}{4}''$ to $\frac{3}{8}''$, leaving a space between the edge of the floor and the outside shell plating as shown at d in figure; it follows, therefore, that any force acting at point C immediately takes effect in shearing the rivets connecting frame to floor. In the space between longitudinals under consideration, there would be eight $\frac{3}{4}''$ rivets and assuming a shearing stress for $11\frac{1}{2}$ tons for each, we have a total resistance to sheer of 92 tons, granted that a force of sufficient magnitude came upon the bottom as

to cause the sheering of the rivets. The floor, deprived of its great source of strength along its lower edge, would in all probability become distorted, and ultimately its effectiveness as a girder seriously impaired, if not entirely destroyed. I have indicated in figures above the probable form the floor would ultimately take under these conditions. In three or four cases which have come under my observation, the effect of grounding has been, to a greater or less extent, as I have indicated and, in addition to the distortion, the frame angles were broken, floor plates torn, rivets in reverse frames started and sheered, and other damage done, although the outer plating was not perforated, except in one instance.

In the case of the "channel" steamer, the transverse frame is composed of a channel bar of scantling, shown in above figure. The distance

between longitudinal in this steamer being 4' 4" and general arrangement and connections to longitudinals as shown in figure below.



According to the maker's (Carnegie Company) tables, a beam of this section, with a span of 4' 4", is capable of bearing (assuming a fibre strain of 8 tons), a distributed safe load of 94¼ tons, which, with a factor of safety of 3½, would equal a breaking load of about 330 tons; comparing this with the sheering of the frame rivets of the "ordinary" steamer—92 tons, it will be at once plainly seen that the "channel" system of construction as applied to the bottom framing of ships is at least 3½ times more efficient in resisting the strain due to grounding under division one. The same line of reasoning can be applied and similar results anticipated in case of longitudinals of the two systems of construction. The deeper longitudinals and the superior stiffening which is afforded to them by the 6" channels increasing the efficiency over that of the "ordinary." I have therefore no hesitation in saying that the "channel" steamer is infinitely superior in power of resisting the deformation of the bottom due to grounding under division one.

We come now to the consideration of the second division, grounding, striking or running on rock; there is a greater liability under this division to have the bottom perforated and torn; so far as resistance to perforation is concerned, it varies almost directly with the thickness of the plate, so that comparing the bottom plating of the "ordinary" and "channel" steamer, the latter is more efficient by about 3 to 4 per cent. The bottom plating once penetrated, it is impossible to predict what damage would result to the internal structure of the double bottom, this depending on the size and nature of the rock and the speed of the vessel at the time of the encounter, as also the part of the ship which "found" the rock. I can make no definite statement as to the merits of the two systems of construction of double bottom framing in an encounter with the destructive power of rock; I may state, however, that in my opinion, the solidity of the channel frames and longitudinals would enable the structure, as a whole, to confine the damage within a smaller compass than the built up framing and longitudinals of the "ordinary" steamer; but apart from this, granted that either vessel is sufficiently strong to resist the ordinary stress of stormy weather and other exigencies of the service in which she may be engaged, I would most decidedly be against any excessive provision for protection against rocks, either by addition to thickness of outer bottom plating, or increase on the scantlings of the internal framing.

Summing up the foregoing, the mode of construction and the form of section employed in the framing of the double bottom of the "channel" steamer would, in my opinion, be more efficient than that of the "ordinary" in confining damage due to grounding (under the supposed conditions) within the limits of the outer bottom, and internal structure supporting same without forcing up the tank top.

Question 4.—Wherein does each plan have superior points over the other?

In my opinion the "channel" steamer has a superior point of paramount importance in the form of the material used in the construction of the frames, web frames, double bottom construction, ties, 'tween deck side and hold stringers, for reasons which I have stated throughout the course of this report, and which it would be undesirable to repeat here.

The material composing the shell is, in my opinion, and as the results of the calculations made in connection with Question 5 go to prove, better distributed, and in consideration of the work which is demanded of it, it is in many respects more efficient, particularly as measured by weight and strength.

The arrangement of the channel ties along top and bottom of this steamer is superior to the arrangements which are fitted to accomplish the same purpose in the "ordinary" steamer, as in conjunction with the upper deck stringer and main deck stringer they support the plating at closer intervals and at critical points. (See replies to Question 7.) The

I strut at center line is an improvement over the "ordinary" plan of same character. The stanchions of the "channel" are more efficiently con-

nected to tank top and to the different decks than those of the other plan. They are also admirably stayed with the plate which is fitted in 'tween decks between hatches.

The spacing of the longitudinals of double bottom are more favorable for supporting the outer bottom plating between the bilge and center than that of the "ordinary" steamer.

In the connection of the main deck stringer to the side of the vessel, the introduction of a 6" channel bar clip instead of the ordinary angle is a notable improvement; as the continuous stringer angle thus gets an almost continuous direct connection with the shell plating through the agency of this bar, this all tends to make the structure more homogeneous, and is conducive towards the development of maximum strength. This feature is an important one, and it is also well carried out in the side and hold stringers. This is certainly an improvement over "ordinary" practice. The only point in which the "ordinary" is superior to the "channel" steamer is strength in a longitudinal direction, but as a result and analysis of the investigation made for replying to Question 5, this strength is more apparent than real, and is obtained at the expense of so much unnecessary weight as almost to wipe out the advantage gained, even with the modifications suggested to improve each plan. The "channel" steamer proves herself superior in almost all other respects.

Question 5.—Work out both plans as to their respective strengths in stress and under load.

The principal strains to which vessels are subjected may be briefly stated as follows:

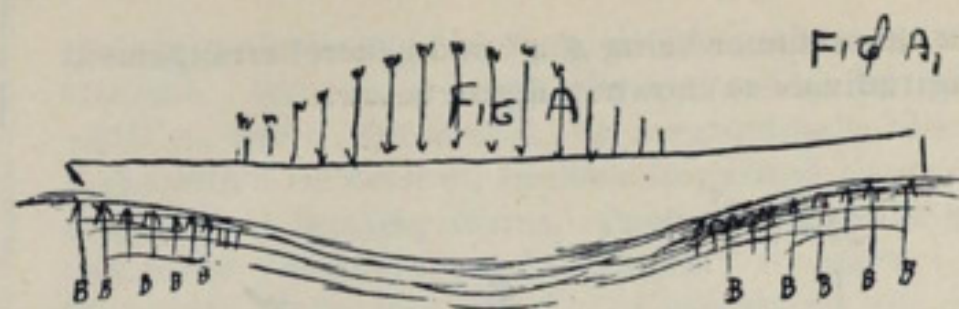
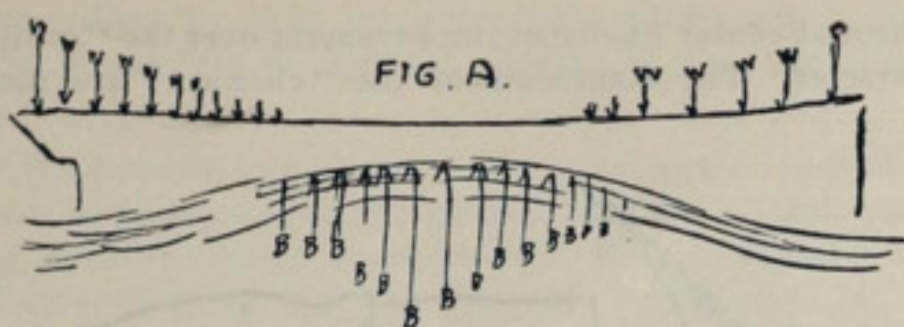
- 1st. Those which tend to produce longitudinal bending in the structure as a whole.
- 2d. Those which have a tendency to change the transverse form.
- 3d. Those which tend to cause local damage or change of form independent of those in the structure as a whole.

The strains coming under the second and third divisions I have dealt with in my replies to other questions, and in answering the above question we will confine ourselves to inquiries regarding the strains to which the vessels are subjected under the first division.

The methods and theories which I have adopted in estimating the longitudinal strains are those universally employed by naval experts in investigations of this kind, that of treating the vessel as a girder, loaded and supported in different ways according to the distribution of the weight of the vessel and of load, and of the buoyancy or supporting forces when among waves.

It has been established that a vessel is subjected to maximum bending forces when traversing waves of her own length, and, while admitting that it is highly improbable that 400 feet waves are ever encountered on Lake Superior, for purposes of comparison with data available (which has been almost universally computed on the basis of each vessel being among waves of her own length) I have preferred to attack the problem along the same lines and afterwards make the modifications which experience and knowledge of the particular case may seem to me to be reasonable.

The first step in the process is the determination of the bending forces which act upon the ship as a girder, 1st, when poised on the crest of a wave of her own length amidships; 2d, when across the trough of the wave with the bow and stern on crest of successive waves. In the first case forces tending to bend vessel are as indicated by arrows, Fig. A, (next page.) Those at the end lettered W being unsupported weights acting downwards, and those at center, lettered B, being excess of buoyancy over weights acting upwards, thus producing bending moments varying in intensities along the length of the ship, the maximum being usually found at or about the middle of the length. In the second case when the vessel



is across the trough the distribution of these unsupported weights and excess buoyancy are changed in position as shown in Fig. A. When on the crest of the wave the upper parts of the ship, stringers, sheer strakes, etc., are subjected to tensile strains, while the keel, bottom plating, and all longitudinal material below the center of gravity of the steel section are undergoing compression. When across the trough the conditions are reversed; that material which on the crest was in tension will now be in compression and vice versa.

To make an accurate estimate of the value of the bending moment in the different conditions of wave and lading, it is necessary to have the lines of the ship and a general arrangement plan of the vessel in order to determine the aforementioned distribution of downward and upward forces on the crest and across the trough of the wave. These, of course, were not obtainable for the vessel at hand and I was forced to make the best use of data available. Fortunately, for this purpose, I made about two years ago exhaustive inquiries into the strength of an ore carrying steamer in actual service, and owing to the probable similarity in form as also the distribution of loads (cargo, coal, etc.) I have been able to deduce from the data I have regarding her, to make an estimate, sufficiently near for all practical purposes, of the bending moments of the vessel under discussion, and any error involved in making the different assumptions, I am confident, will be inappreciable.

Having obtained these bending moments, the next step was to determine the resistance which the material, as shown in the midship sections sent me for the two vessels, was capable of offering, by use of the well known formula $\frac{P}{y} = \frac{M}{I}$ where:

P=stress per square inch.

M=bending moments obtained as above described.

y=leverage with which the bending forces act.

I=moment of inertia of the section of the ship, or on our supposition, the girder equivalent.

From which we have $P = \frac{My}{I}$

I and y are computed direct from scantling sections, and in doing so, the rivet holes of the parts under tension have been deducted, while in those under compression the gross section of plate or angle has been taken. No account has been taken of the contributions to the strength of wood ceiling; when the bottom of the ship is in tension, the ceiling is of no use, and its value when in compression is unreliable and doubtful.

Having described the basis upon which the comparison of the strengths of the two vessels have been made, the results of the calculations, taking the material of the two vessels as represented in scantling sections, are as in the following table:

VESSEL ON CREST OF WAVE OF HER OWN LENGTH—400 FEET.
"HOGGING STRAIN."

STEAMER.		"ORDINARY."				"CHANNEL."			
		IN BALLAST.		LOADED.		IN BALLAST.		LOADED.	
		1000 Tons.	2000 Tons.	14' 9"	20' 0"	1000 Tons.	2000 Tons.	14' 9"	20' 0"
Tension	Tons								
on upper	per								
deck stringer.....	sq. in.	7.23	7.26	7.03	6.87	9.27	9.30	9.01	8.81
Compression	"								
on keel.....	"	3.95	3.97	3.84	3.75	4.01	4.03	3.90	3.82

VESSEL ACROSS TROUGH OF WAVE—400 FEET CREST TO CREST.
"SAGGING STRAINS."

STEAMER.		"ORDINARY."				"CHANNEL."			
		IN BALLAST.		LOADED.		IN BALLAST.		LOADED.	
		1000 Tons.	2000 Tons.	14' 9"	20' 0"	1000 Tons.	2000 Tons.	14' 9"	20' 0"
Compression	Tons								
on upper	per								
deck stringer.....	sq. in.	4.36	5.52	7.34	9.22	5.20	6.59	8.76	11.00
Tension	"								
on keel.....	"	3.09	3.92	5.21	6.54	3.22	4.08	5.42	6.81

Examining the figures of the foregoing tables we find that upper deck stringer of the "ordinary" steamer has tensile stress ranging from 6.87 to 7.26 tons per square inch, alternating with a compression of from 4.36 to 9.22 tons as against 8.81 to 9.30 tension and 5.20 to 11 tons, compression in the "channel" steamer, or, taking the maximum of these, the material of the "ordinary" steamer is subjected to less tensile and compressive strains than that of the "channel" steamer by 22 per cent. and 16¼ per cent. respectively. Taking the corresponding values of stress on the keel these show a difference of 4 per cent. and 2 per cent. respectively in favor of the "ordinary." While this comparison goes to show that the "ordinary" is apparently stronger than the "channel" steamer it does not prove that the latter is weak.

In order to deal with this phase of the question we must have some criterion or standard; this can be got only from the result of observations and experience with vessels already built.

After careful study of the whole matter and taking into account on one hand the fact that a 400-foot vessel, as I said before, is never likely to meet with waves of her own length on the lake (this being the condition of maximum straining) and on the other hand, allowing for the severe "jarring" strains to which the vessel is subjected when running in ballast, and in taking the ground, as also from the severe treatment they receive in loading up with iron ore, and other peculiarities of the service, I am confident that a vessel of this size, engaged in the ore carrying trade on the great lakes, will be amply strong with the maximum tensile stress of 8½, possibly 8¾ tons, and a maximum compression of 9½ to 10 tons, providing she is carefully designed and the material so distributed as to offer the greatest resistance possible to transverse, racking and other strains. The reason why I have fixed upon a higher compressive strain than that for tensile, I will deal with at a later point. It must be distinctly understood that the figures here given are by no means to be looked upon as the actual strains on a vessel in a seaway; they are simply functions of strains, as derived by the present methods adopted for comparing ship with ship. Although the exact relationship which they hold to the actual strains is not at the present time known, they are eminently useful as forming a basis of comparison of the strengths of different vessels.

Accepting these figures of say 8½ tons tension and 9½ tons compression as a criterion, taking the maximum figures in each case, the "ordinary" steamer shows an excessive strength at the upper deck stringer in tension of 14½ per cent. and in compression 3 per cent., while measured by the same standard the "channel" steamer shows a deficiency of 9.4 per cent. and 15¾ per cent. respectively; both vessels are well in hand so far as strains coming on bottom.

The elements of size and proportions figure very largely in making comparisons, and as may be gathered from what I have written here, while 10 tons may be a safe strain to carry in a large vessel, it by no means follows that a like strain will be safe in a vessel of smaller dimensions. For example, take the 500 to 600 foot ocean liners; some of these have as high as 10½ tons, the average of the best practice may be put at about 8 tons, while the 400-foot vessel engaged in the same trade probably averages only from 6½ to 7 tons. In confirmation of these remarks, regarding the element of size, I append a curve showing tensile stresses per square inch plotted on basis of gross register tonnage. It has been drawn from the results of calculations of ships classed at Lloyds, particulars of which were given in a paper read by Mr. John, who at that time was one of the officials of the society, I think it was in 1877. These were iron ships, and Lloyds have since made considerable additions to the scantlings of vessels, so that at the present day the values as shown by curve will be reduced. The curve as given is for vessels of about 8 beams and 11 depths in the lengths. The vessels under discussion have about 14¼ depths in lengths, but against this excess of proportion we should place the fact that the stresses were for iron ships. Steel ships should be able to bear greater strains in almost the ratio of the ultimate strength of the two metals $\frac{27}{20} = 1.35$ and in spite of additions made to the scantlings, the last consideration would balance off the excess in proportions; assuming this to be the case, the figure of 8¾ tons tensile strain which I have adopted leaves a considerable margin over 10 tons as obtained from the curve for a vessel of about 3,900 tons register, this being the tonnage which I estimate the vessels we are discussing would have.

In my reply to Question 11 and throughout the body of this report, I suggested various modifications in the construction of both vessels, chiefly with a view to increasing their efficiency in resisting transverse and other strains. As therein noted, the additional material, or the redistribution of existing material, has been made in such a way as to serve the purpose for

which they were introduced and at the same time lend their aid in taking the longitudinal strains. In view of the excess of strength of the "ordinary" steamer, I analyzed the distribution of her material, and I find that she owes her strength entirely to the doubling of the sheer strake and strake below. As a modification in her construction, I would propose doing away with these doublings and increasing the thickness of the strake below sheer to that of the side plating (28 pounds).

With the modifications proposed for the two steamers, the longitudinal strength would be as in the following tables:

VESSEL ON WAVES OF HER OWN LENGTH.

STEAMER.	"ORDINARY."				"CHANNEL."			
	IN BALLAST.		LOADED.		IN BALLAST.		LOADED.	
	1000 Tons.	2000 Tons.	14' 9"	20' 0"	1000 Tons.	2000 Tons.	14' 9"	20' 0"
ON CREST OF WAVES.								
Tension on upper deck stringer..... Tons per sq. in. }	8.24	8½ to 8¾ 8.28	8.02	7.84	8.51	8½ to 8¾ 8.55	8.28	8.09
Compression on keel..... "	4.07	4.09	3.96	3.87	3.78	3.80	3.68	3.60
ACROSS TROUGH OF WAVE.								
Compression on upper deck stringer..... Tons per sq. in. }	4.87	6.17	8.21	9½ to 10 10.30	4.60	5.82	7.74	9½ to 10 9.72
Tension on keel..... "	3.21	4.07	5.41	6.79	3.06	3.88	5.16	6.48

An examination of the figures in these tables shows that the maximum stress on the material of each vessel has been brought within the figures which I have decided upon as the standard (the latter I have placed above the maximum in each case). The only condition which is not fulfilled is the compression on the stringer of the "ordinary" steamer, which stands at 10.3 tons. This can be reduced to the 10-ton standard by increasing the thickness of the sheer strake from 28 to 33 pounds; with this modification, so far as longitudinal strength is concerned, I am satisfied that the "ordinary" steamer would be amply sufficient.

The "channel" steamer, as modified, fulfills the conditions laid down admirably. It is interesting and instructive to study the distribution of the material composing the shell in the two vessels. Leaving out of consideration the sheer strakes and keel, which are practically the same in each, the "channel" steamer has the thicker bottom and a thinner side. In the "ordinary" steamer this is reversed. Now, as an additional protection against damage from grounding, the "channel" steamer has the advantage, while her side plating braced as it is by the superior solidity of the channel bar frames and web frames, as also by the double stringer on upper and main deck beams and the 'tween deck and hold stringers, is capable of sustaining equal if not greater strains than that of the "ordinary." The saving of weight in the shell plating of the "channel" steamer over that of the other is self-evident.

To attain the same efficiency, the material of the "ordinary" steamer would require to be distributed in much the same fashion as the "channel"; but having done this, all need for comparison would cease to exist (as both would be similar), so I will leave the matter as it stands to be decided, with what I have said, on its merits.

In a preceding paragraph I promised to explain why I adopted a higher value for compression than for tensile stresses. I have already stated that these figures are not actual strains, but are some function of the strain; a nearer approach to the actual strain can be obtained by taking the "wave structure" into account in making the calculation for bending moments. It is assumed that the whole of the wave formation has an equal buoyancy throughout the structure. This is not the case, however. The buoyancy of wave water for a given volume of displacement is less at the crest and more at the trough of the wave than the weight due to the volume displaced. If this fact is taken into account the effect is to reduce the bending moments calculated on the ordinary assumptions, those for the crest of wave being reduced by about 25 per cent., while those in the trough by about 50 per cent. Another interesting feature in connection with this is that as the draught increases the reduction of the bending moment, due to the same causes, rapidly increases also, so that as the draught is increased we would ultimately get a condition of things in which the bending moment would be nil; unfortunately the lake steamer has no hope of ever getting there, but it is nevertheless interesting to note. There are still other causes which are known to exist—pitching and ascending, vertical oscillations, etc. If these could be dealt with satisfactorily we would be able to get a still closer approximation to the actual strain, but this would require long and expensive experiment in model tanks and with vessels at sea. These, however, are difficult to obtain.

The stresses per square inch, taking wave structure into account, would then be shown in the following table:

STEAMER.	"ORDINARY."				"CHANNEL."			
	IN BALLAST.		LOADED.		IN BALLAST.		LOADED.	
	1000 Tons.	2000 Tons.	14' 9"	20' 0"	1000 Tons.	2000 Tons.	14' 9"	20' 0"
ON CREST OF WAVE—400 FEET.								
Tension on upper deck stringer..... Tons per sq. in. }	7.53	7.32	6.45	5.21	7.66	7.44	6.54	5.21
Compression on keel..... "	3.93	3.84	3.39	2.69	3.67	3.59	3.17	2.52
ACROSS TROUGH OF WAVES.								
Compression on upper deck stringer..... Tons per sq. in. }	2.44	3.09	4.11	5.15	2.30	2.91	3.87	4.86
Tension on keel..... "	1.61	2.04	2.71	3.40	1.53	1.94	2.58	3.24

As will be noted, these strains approach more nearly our ideas of what steel is capable of withstanding, but as at the present time comparisons are made and published data are all on the basis of leaving the "wave structure" out of account, the previous tables are of more service, although the above is interesting as being more nearly representative of the probable actual strain.

Question 6.—Especially notice any weak or over-strong parts in either plan, and give results of your calculations.

In reply to this question, in order to save repetition, I beg to refer to the reply to previous questions, as also to those of Questions 7 and 11.

Question 7.—Which plan shows the better side stringers?—The better arrangement of web frames?—Stanchions and connections?—Deck beams and connections?

The arrangement of side stringers of the "channel" steamer between main and upper decks is a valuable contribution to the strength of the vessel; the heights between deck in both the "ordinary" and "channel" steamers are greater than usual, and the precaution taken to divide up the space and reinforce the framing at this point in the latter steamer is, in my opinion, a wise measure. The absence of reverse frames on every alternate frame of the "ordinary" steamer calls, I think, for the addition of somewhat similar arrangements in her case. The hold stringer of the "ordinary" steamer is certainly stronger than that shown for the "channel" steamer, but with the additional 15" channel bar running continuously on face, which I purpose to fit to the hold stringer in her case, and taking into account the greater solidity of the channel bar construction, I consider it to be sufficient for the work it will be called upon to perform.

The web frames of the "channel" steamer, taking into account the closer spacing, and the association with the superior subdivision of the sides of the vessel by the decks and side stringers, are equally as good, if not better, than those of the "ordinary" steamer.

Regarding the spacing of web frames, it is important to note that with a 24' spacing of hatchways, center to center, that the 8 ft. spacing of the web frames in the "channel" steamer allows a web frame to come abreast of each end of hatchways, with one between each hatch, whereas, in the "ordinary" steamer, with 12 ft. spacing a web frame comes at only one end of each hatch, while the next one is distant 4 ft., or two frame spaces away from the other end; in view of the fact that these hatchways are points of local weakness, peculiar to all vessels engaged in the ore carrying trade of the lakes, every precaution should be taken to brace the structure of the ship in the vicinity of these large openings, and in this respect the "channel" steamer has a better spacing of web frames. One other advantage which may be claimed for the web frames of the "channel" steamer is the smaller projection of these in the hold, and consequently a lessened interference with cargo, compared with those in the "ordinary" steamer.

As to the deck beams, the channel form of beams is equal in every respect to the bulb tee, so far as individual strength is concerned; one of the advantages of the channel form is the facilities which the lower flange offers for the connection of under beam ties, and should bracket knees be adopted, these can be applied with greater ease than to the bulb tee beam, as in the latter form of beam it is necessary to chip off the bulb on one side to allow of the bracket being fitted.

For beam connections, see reply to Question 11, wherein the question of beam knees is discussed at length.

Question 8.—Do you consider quarter-stanchions in boats of this width necessary?—No deck is laid on main deck beams.

Vessels of the widths specified (48 feet), and with the ordinary system of construction, should, in my opinion, have at least two rows of stanchions

fitted, or as an alternative, one row at middle line with a row in each side, these latter spaced twice the distance apart of those at center. The "ordinary" steamer in this respect is very satisfactory, providing that the wing stanchions are not in any way maltreated; from what I know regarding the ore carrying trade and the methods of loading and unloading steamers engaged in the service, there is a very great danger of the wing stanchions being bent and broken. Wing stanchions are a nuisance in any trade, and it is desirable to do away with them if possible.

Beams, as originally fitted, were intended to support the decks with their loads; but they have other uses, as the various strains due to grounding, rolling, etc., are brought on the structure of the ship, the tendency will be to alternately increase and decrease the distance between the sides of the vessel; the beams of the different decks, therefore, act alternately as ties and struts. Similarly, stanchions were originally fitted to support the beams, and in the tendencies to produce alteration of transverse form indicated above, the stanchions are subjected alternately to a pull and thrust. It is in this work that the wing stanchions play an important part, but if the necessities of the case render it desirable to do away with them, it will be necessary to take care of the transverse strains in some other way. This I purpose doing by methods indicated in my reply to Question 11.

Question 9.—Which plan shows the better sheer strake and deck stringer?

So far as thickness is concerned, the "ordinary" steamer has the better sheer strake and deck stringer. The result of the calculations, however, connected with the longitudinal strength show that the doublings of sheer are not required. In replying to Question 11, I have proposed improved methods for the connection of the beams to the side of vessel in lieu of beam knees in the "channel" steamer. The double stringers fitted would be more efficient than those of the "ordinary" steamer.

Question 10.—Would a boat built under either plan, be a good, serviceable and seaworthy vessel for use on the lakes, and if in your opinion there is any choice, which do you consider the better?

A vessel built under either plan, so far as principles of construction are concerned, would be a good, serviceable and seaworthy vessel, but not equally so; of the two steamers, with the necessary modifications, such as I have indicated throughout this report, the one constructed on the "channel" system of construction would prove to be in my opinion a better and more serviceable vessel, while both might be equally seaworthy.

Question 11.—What suggestions can you make that would improve either plan?

In reply to Question 8, I expressed an opinion in favor of wing stanchions, chiefly on account of the part they play in transmitting to the beams of the different decks part of the forces which may come upon the bottom of the ship tending to push it upwards as in the case of grounding; or when vessel is passing over the trough of wave where the weight of the cargo, etc., has a tendency to push the bottom down. In either of these cases the wing stanchions are valuable auxiliaries to the stanchions at the middle line; in the working of the ship in a seaway they also assist as ties or struts in preserving the transverse form, but in view of the liability to damage from various causes, particularly in the unloading of cargo, the policy of fitting them is a questionable one; if they are not fitted, some other arrangement must be made to undertake the duties which they are supposed to perform. I propose dealing with the "channel" steamer first. In Question 3 it is stated "that when the stranding is severe enough to do damage, it be confined to the bottom without forcing up the tank top." In my remarks with reference to the effect of grounding (of the first division) on the bottom of the ship I gave as my opinion "that if the grounding is over a relatively large part of the length, the longitudinals of any vessel will contribute very little toward the longitudinal strength as they will simply move up with the bottom." From this we see that we cannot hope for any aid from the longitudinals as a substitute for wing stanchions in helping to prevent this heavenward tendency of the bottom; the only thing that is left for us to do is to call upon or substitute something in the transverse direction, as we know the sides of the vessel sinking down will at the same time help to hold down the ends of any transverse member of the construction that is fitted in this locality.

I would therefore propose that at every 8th frame—web frame—a 15"x33lbs. channel bar be fitted right across on each side of middle line at the top of tank, but on the under side of tank top plating (in the position of the ordinary reverse bar in double bottoms built on the bracket floor plan), this bar to be efficiently connected to the A bracket plate on the center girder and to bilge bracket plate; then at the top of each longitudinal, instead of running the longitudinal plate up to the tank top plating, I would fit channel bars of the same size in 8 ft. lengths intercostal between the top transverse bars, the continuous longitudinal plates would then be fitted between the top and bottom intercostal channel bars and be connected thereto with either angles of a suitable size or by flanging the top and bottom edge of the plates, the 6" channels being fitted vertically as already shown in section of "channel" steamer; this proposed modification

is illustrated in drawing of section appended to this report.* By this means, the double bottom is additionally stiffened transversely and I think does away with the necessity of wing stanchions so far as their service in connection with the bottom is concerned. In addition to this, the formation of these transverse points of support at every 8 ft. of the length, bind the longitudinals down and force them to take some share in overcoming the lifting tendency of the bottom, whether the grounding is concentrated or extended over a large area; of course, they act as efficiently in counteracting any downward tendency of the bottom in a seaway; apart from this, they are a continuation right around the ship of the web frame, thus forming a valuable band structure in maintaining the form in transverse direction and also against torsional and racking strains.

Assuming the length of double bottom 280 ft. and the average length of a longitudinal 200 ft., the additional weight involved would be roughly:

Credit.	Pounds.	Debit	Pounds
Wt. reduction in depth of long's.....	35000	Wt. transverse channel.....	41580
Wing stanchions.....	29240	Long's.....	52800
	64240		94380
		Less.....	64240
		Additional weight.....	30140
		Say equal 13½ gross tons.	

The gain in the strength, both local and in general, as also the doing away with the obnoxious wing stanchions balances off the additional weight and extra cost of riveting and fitting involved, and is the best arrangement I can think of at present to meet the case.

A somewhat similar arrangement could be adopted in the case of the "ordinary" steamer, only in her case in all probability in lieu of the transverse channels, solid plates lightened with manholes fitted intercostally between the longitudinals spaced on every web frame (12 feet apart) could be fitted, the longitudinals remaining as at present arranged; the additional weight and cost would probably be about the same, possibly heavier, as that estimated for the "channel" steamer. The construction of the double bottom of this steamer does not, however, lend itself so readily to improvement in this direction as that of the "channel."

Replying to one of the queries of Question 7, in reference to "deck beams and connections," it occurred to me to offer a suggestion in the way of an improvement on the ordinary system of connecting the deck beams to the sides of the vessel which the channel form of beams in the "channel" steamer renders easy of application.

As stated elsewhere, besides serving to support the decks, the beams lend their aid in supporting the bottom and keeping it in place. They also keep the sides of the ship together and prevent them from spreading or collapsing under the action of forces acting in alternate directions. In order to perform these functions they are connected to the frames by knees and to the deck stringers through the top flanges. Now it is surprising the number of vessels that one hears of showing signs of working at the beam knees, while apparently not strained in any way in the vicinity; in fact it is a chronic complaint, this weakness in the knees—it is very difficult to account for it, unless it is that the forces acting along the axis of the beams use the knee as a lever in trying to have their own way, and in this way work their own destruction. Some years ago, in scheming out the scantlings and structural arrangements of the City of Paris, now the Paris of the American line, an arrangement was suggested of connecting the Z bar beams (channel sections of steel were not so prominent at that time) to the ship side by doing away with the knees altogether, in lieu of which it was proposed to fit a stringer plate on the under side of beams, riveting thereto and scoring it over the frame and connecting it to the shell in the usual manner with intercostal clips having also a continuous stringer angle running along face of Z bar frames (she has 7" Z bars spaced 32" apart). This plan was approved by Lloyds and was fitted in the New York and Paris, and up to date no trouble has been reported with the beam connections, and I am almost convinced that it is because the forces act more direct and in return meet with direct resistance. The fitting of this under beam stringers forms at the same time a complete girder formation, bracing the sheer strake and assisting the beams in maintaining their length against upward and downward forces transmitted through the stanchions, and, what is perhaps one of their chief points while doing all this, they contribute directly to the longitudinal strength, and in this last particular taking the place of doubling the sheer strake and doing the work as efficiently, and, in my opinion, much more so. I have shown this modification in section appended, and would propose its adoption as an improvement on existent practice. The same could be applied to the "ordinary" steamer, but in her case the bulb T beams would increase the cost, as the bulb would require to be chipped off to permit the fitting of an angle iron along the lower edge for connecting the stringer plate and as the reverse frames extend to the upper deck on alternate frames only, the continuous stringer angle would require to be connected to lugs specially fitted on these frames. If these obstacles are not insurmountable I would suggest the improvement in her case also.

*Plans referred to here and in other paragraphs under this question are not at hand but will be found in the supplement to the register, which will contain this report.

In the "ordinary" steamer it will be desirable, I think, to fit the angle, which is shown on the inner edge of main deck plating between the beams, and allow it to act as a distance piece or strut to assist in preventing the beams spreading at quarter beam when subject to compression. In its present position is it not liable to be broken with cargo knocking against the standing flange? And for the same reason, I beams, or fore and afters, should certainly be fitted between the beams at middle line.

In the same steamer I would suggest that the main deck beams be straight, for the same general reason given in the reply to Question 4, when speaking of those of the "channel" steamer.

The keel plate of the "ordinary" steamer, to my mind, is too narrow. It should be at least 36" wide, for no other reason than taking the edge lap with the garboard further away from the heel or frame where there is always a tendency to "kick."

In the "ordinary" steamer, the liner fitted between butt straps of the sheer strake and interposed between that strake and the upper deck stringer angle is very obnoxious; liners employed in such vital points of the ship's structure is very bad practice; better to go to the expense of joggling the angles over the straps.

The middle line stanchions of the "ordinary" steamer are not so efficiently connected at tank top and to the beams as I would care to see them; those of the "channel" steamer might well be adopted.

The angles on top of longitudinals, connecting them to top plating of tank of the "ordinary" steamer, should be placed on the opposite side of plate, in order to allow the vertical angle going right up to the top, and, if possible, have a through rivet connection with continuous angle. The bilge bracket plates on both outside and inside of double bottom should have their inner edge either flanged or reinforced with angle of the size of reverse frame.

In the "channel" steamer modified section, appended to report, I have placed a continuous 15" x 33 pounds channel bar on the hold stringer face, this being in the vicinity of the neutral axis of the structural material. Reverse racking oftentimes occurs here in vessels, which it is desirable to resist with continuous as well as intercostal work.

Suggestions in connection with redistribution of the material forming the shell of the "ordinary" steamer will be found in reply to Question 5.

I have reduced the thickness of the side plating of the "channel" steamer as shown on modified section, this being all that is required; if for local considerations it may be thought desirable to maintain the original thickness, it will do no harm, but will only be so much more material added unnecessarily.

In consistency with remarks on the question of the margin plate connection to ships, I would advise the cutting of the frame of the "ordinary" steamer at the margin plate and connecting it in the usual manner with double angles.

Question 12.—Is there anything, in your opinion, in either plan that is radically against good construction, either in the shapes or kind of materials used or the manner adopted for putting them together?

So far as it is possible to judge from the midship sections handed to me of the two systems of construction, provided the suggestions for improvement given in replies to Question 11 are carried out, there is nothing in either steamer that violates what may be termed good practice in this class of steamer.

Question 13.—What is your opinion of the so-called channel system of construction?

Having had considerable experience in my business career with the fitting of both Z and channel bars to the framing, beams and other parts of the structure of vessels of the highest class in the mercantile marine and war vessels, I was very much interested in these investigations into a vessel in which the channel bar entered so largely into the construction. I have taken great pains, and gone through an immense amount of labor, weighing each detail, and viewing it from every standpoint, not only to enable me to render a conscientious report on the merits of the two systems of construction, but from the professional interest which I have as a designer in all that tends to the production of the best vessel, for whatever work intended, and I must say that, with the modifications which I have suggested, I consider the "channel" steamer as submitted for investigation, is eminently adapted to perform the work for which she has been designed.

Question 14.—If you think favorably of it, give your opinion as to wherein it is better than the old plan. Also, anything that may be unfavorable to it.

If we take the two systems of construction, so far as form of material is concerned, the shell plating is the same, stringers and deck plating are the same, the tank top is the same, the longitudinals are the same, bracket connections the same, middle line stanchions are the same; we are left then with the following, in which channel bars have been substituted for angles, plates, or combinations of both:

PARTS OF STRUCTURE.	"ORDINARY."	"CHANNEL."
Frames.....	Angles.....	Channel bar
Reverse frame	"	"
Web frame.....	Plates and Angles..	"
Trans. framing of D bottom.....	"	"
Intercostal framing of D bottom.....	"	"
Verticals.....	Angles	"
Beams.....	Bulb T	"
Deck ties.....	Plates.....	"
Hold stringers.....	Plates and Angles..	"
Top side stringers.	None.....	"
Chock pieces to stringers	Angles.....	"

Without one word, a glance at this list, first down names of the structures, then down the column headed "ordinary" with the combinations of angles and plates of which they are composed, keeping at the same time well in mind the separate cutting, sheering, trimming, chipping, marking off, punching, boring, fitting and riveting; then, resting the eye on the last column headed "channel" should, I think, convince the greatest stickler for old fashioned ways of the superiority of the new type of construction.

Every part of the above structure and that previously mentioned has been dealt with, and the results of the calculations, some qualitative and some quantitative, given, with exception of frames and reverse frames. As the transverse framing is one of the most important parts of the vessel's structure, we will examine a few facts bearing on the subject of angle frame and reverse vs. channel or Z bar, both of the latter belonging to the same family, although in practical operations, the channel lends itself more readily to manipulation. From a number of experiments, part of which were carried out by experts connected with Lloyds, others carefully made at the experimental department of the ship yard with which I was at the time connected, I have selected the nearest to our particular case.

Each, combined frame and reverse frame riveted together, as also Z bar and channel bar, was supported near each end, the distance between supports was 7 feet, a load of 10 tons was placed exactly at the center between supports and the deflections measured. These, with the sizes, etc., being as shown in the following table:

COMBINED FRAME AND REVERSE ANGLES.

	Size.	Area in square inches.	Area X depth.	Deflection in inches.
Frame angles.....	5X3X $\frac{5}{16}$	5.15	25.75	.87
Reverse frame angle.....	3X3X $\frac{1}{8}$			
Frame angle.....	5X3X $\frac{5}{16}$	6.18	30.90	1.02
Reverse frame angle.....	3X3X $\frac{7}{16}$			
Mean.....		5.67	28.33	.95

SOLID SECTION FRAME.

	Size.	Area in square inches.	Area X Depth.	Deflection in inches.
Zee frame.....	5X3 X3 X $\frac{5}{16}$	4.54	22.7	.78
Channel frame.....	5X3 X2 $\frac{1}{2}$ X $\frac{5}{16}$	3.885	19.425	.83
"	6X2 $\frac{1}{2}$ X2 $\frac{1}{2}$ X $\frac{5}{16}$	4.088	24.528	.83
Mean.....		4.171	22.327	.813

Taking these results, and assuming that the deflection varies roughly as the area X depth of bar, we have for "ordinary" steamer frame $6'' \times 3\frac{1}{2}'' \times \frac{5}{16}'' = 3.97$ square inches sectional area; reverse frame $4'' \times 3'' \times \frac{7}{16}'' = 2.87$ square inches sectional area. Total sectional area = 6.84 square inches, which multiplied by depth (6') = 41.04. We have from the above:

$$\text{Deflection} = \frac{.95 \times 28.33}{41.04} = .656 \text{ inches.}$$

And for the "channel" frame $6'' \times 3'' \times 3 \times 18$ pounds = 5.3 sectional area, which multiplied by depth (6') = 21.8; then from the above we have

$$\text{Deflection} = \frac{.813 \times 22.33}{31.8} = .571 \text{ inches.}$$

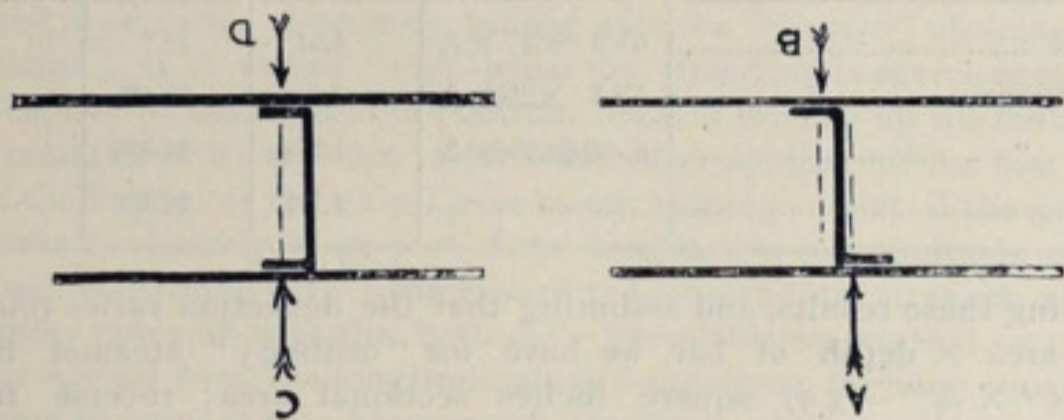
On this basis (and from other results which have been obtained—I know they are not far from the truth) a channel bar of the size of the "channel" steamer's frame, with about 22½ per cent. less sectional area, is capable of standing a load of 10 tons, with 7 feet between the supports, and show about 14¾ per cent. less deflection. This is what actual experiment shows. If we were to make the theoretical calculation for the two cases, we would get results which would be approximately near the truth for the Z or channel bar; but in the case of the combination frame the calculated results would vary from 25 per cent. to 40 per cent. less deflec-

tion than what experiments have shown. But it is in direct confirmation of what I have already spoken of in dealing with the transverse frames of the double bottom of the "ordinary" steamer. In a combination frame all sheering stresses are communicated from the frame bar to reverse through the connected rivets. So that, instead of the force, whatever it may be, acting on each particle of the longitudinal section of the bar, it acts on the rivets only. In the "ordinary" rivets, connecting frame and reverse bars would be $\frac{3}{4}$ " diameter, spaced 8 diameters apart, and a thickness of the channel bar being .48", the stress which is borne by one $\frac{3}{4}$ " rivet = .442 square inch, would be resisted in the channel bar by $6'' \times \frac{3}{4}'' \times .48'' = 2.16$ square inches. The strain of the former case must therefore be greater than in the latter. The frame of the "channel" steamer by this method has been shown to be much more efficient in resisting bending forces than the compound frame of the "ordinary" steamer.

The results as shown by experiments in the case of typical frames of different forms of construction can be relied upon; it is reasonable to suppose that a corresponding efficiency would follow in the majority of cases where channel bars are substituted for built up structures, so that, on this theory, a ship into which channels are largely introduced, as in the case of the "channel" steamer, must be either one of two things; she must be for the same sectional area of material stronger, or for the same strength she could have less sectional area and consequently less weight than a vessel built on the old system or as "ordinary" steamer. Less weight of material means lessened cost, and, while it is true that channels are dearer than angles on the market, the lessened cost, due to less weight, combined with decreased labor cost on riveters, and to a less extent fitters, borers, angle iron smiths, etc., should more than wipe out the former and leave a balance on the credit side of the ledger. The ship owner who has to pay for the ship should get the benefit; he also gets a lighter ship, is able to carry the same cargo on a lesser consumption, or an increased cargo on the same consumption; or, where the difference in the weight of the two systems is considerable, he can have a smaller ship to carry the same cargo. A lessened ship means a smaller weight of ship; this reduces the displacement. Reduced displacement means reduced power, a reduced coal weight and coal bill—and so the process of reduction goes on until the saving in weight due to the adoption of the "channel" system of construction, of say 200 tons, may ultimately amount in the aggregate to a total reduction of from 300 to 400 tons; a considerably reduced first cost, lessened running expenses, insurance, etc., and, the proposed money earning remaining constant, yields him a larger return on his investment.

From the ship builder's standpoint, when the workmen have become as accustomed to the tricks of the channels as they are familiar with those of the angles, the work is got on with more readily, standing charges are reduced, the net result being an increase or addition to the price received. Channel bars can not, with advantage, be used in the construction of small vessels, as the distance between the flanges will not permit of the holding-on tools being held against the heads of the rivets. For these, however, Z bars can be substituted and used.

One advantage which the channel has over the Z is this: Supposing we have two plates resting on the ground separated with a Z bar, and another plate separated with an equivalent channel bar (see sketch):



A force acting down at A on the Z bar, a corresponding reaction from the ground comes at B; here we have a couple tending to "trip" the bar, which it endeavors to do and shirk its proper work; while in the case of the channel bar, the same force applied at C, the reaction from the ground passes through the same axis, and the channel simply says: "Stand from under, when I break I come down."

Question 15—Would any builder be justified, from a serviceable and seaworthy standpoint, in declining to build under either plan?

This is a peculiar question to answer under the circumstances, but I do not see wherein any builder would be justified in declining to build a vessel under either plan, provided he was allowed to make the alterations which his experience and judgment led him to suggest. This is a reply to the question as I read it.

But supposing the question had been phrased thus: Would any builder be justified, from a serviceable and seaworthy standpoint, in declining to build according to either systems of construction?

My reply would be: As the "ordinary" is along the lines of established practice, leaving out minor details of construction about which opinions might differ, no builder would be justified in declining to build according to the plan.

And no progressive builder, who was anxious to give his client the advantage of the best the market could supply, would refuse to build under the "channel" system of construction, representing as it does simply an extension of the best modern practice.

GEO. R. McDERMOTT,

Professor of Naval Architecture, Cornell University.

ITHACA, N. Y., July 1895.

APPENDIX.

Since writing the foregoing, I have made an extended trip on the great lakes, during which I was afforded opportunities of critically examining the details of construction of different types of vessels, and the conditions of service in which they are engaged, more particularly those in the ore and grain carrying trades. As a result of my observations, and from the information generously furnished me by those engaged in the management, working and navigation of these vessels, my convictions as to the superiority of the solid bar—channel or zee—over the ordinary system of combined angles are, if possible, still more firmly fixed. A number of vessels which I saw built upon the "channel" system of construction, similar to that which I have dealt with in this report. One of these, the Kearsarge, underwent, some time ago, a severe experience in grounding. The details of the damage which resulted coincides almost entirely with what I would have predicted, and showed most unmistakably the superiority of the solid bar construction over that of the combination plate and angle floors and longitudinals.

Through the courtesy of the president of the Interlake Company, I had the privilege of proceeding on the maiden trip of the Victory, one of the latest vessels constructed on the channel system, and was thus afforded an opportunity of observing her behavior while running light and loaded, and in every respect she behaved admirably. In order to test the vessel's strength and stiffness, I made careful measurements of the deflection in a longitudinal direction after receiving cargo—3700 gross tons—and found that it amounted to only $1\frac{1}{8}$ inches, while the loss in camber of beams averaged about $\frac{1}{4}$ inch, with her full cargo on board; and, loaded down to 20 feet draft—probably 6300 gross tons—I do not expect that the deflection will be more than $3\frac{1}{2}$ to $3\frac{3}{4}$ inches in heavy weather. This, I am of the opinion, is the very strongest evidence of the solid staunchness of the channel bar form of construction.

GEO. R. McDERMOTT.

ITHACA, N. Y., Aug., 1895.

FROM LAKE AND COAST BUILDERS.

COPIES OF LETTERS IN REFERENCE TO THE CHANNEL SYSTEM OF CONSTRUCTION—SHIPS TO WHICH IT HAS BEEN AND IS BEING APPLIED.

OFFICE OF UNITED STATES STANDARD STEAMSHIP OWNERS',
BUILDERS' AND UNDERWRITERS' ASSOCIATION, LIMITED,
16 Exchange Place, New York, August 23, 1895.

Dear Sir: In accordance with your request, I beg to submit the following report on the "channel" system of construction introduced by our association and provided for in Sec. 43 of the rules for the construction and classification of iron and steel vessels, and the results obtained with this style of construction.

1. The following vessels have been built or are in course of construction at this date, in substantial accordance with Sec. 43, that is, with channel sections for frames, web frames, beams, floors, ties, stringers and stanchions, namely:

Steamer	Kearsarge.....	3093 tons
Schooner	Malta.....	2237 "
"	Marcia.....	2237 "
Barge	Aurania.....	about 4000 "
Steamer	Victory.....	3774 "
"	Yale.....	about 3500 "
"	Zenith City.....	3850 "
Schooner	(building).....	about 4000 "
"	".....	" 4000 "
"	".....	" 4000 "
Steamer	".....	" 4000 "

These vessels are all built, or building, for the class of "A1" for the term of 25 years in the association's register book, and the scantlings, materials and workmanship are in accordance with the rules of the association. In addition to the vessels enumerated, quite a number of large steel steamers are building which contain some of the features of the "channel" construction but are not under the rules of the association. In short, I have to report that, as far as the framing of our lake vessels is concerned, the old method of angle frames and reverse frames riveted together has

been practically abandoned in favor of the construction introduced and advocated by the association.

2. The merits of this system of construction from the constructor's standpoint has been fully described in the accompanying letters, and I will, therefore, only speak of the practical results that have come under my observation in vessels built on this principle, having made trips in some of these vessels on the lakes and watched their performance, running light and with a full cargo, and having surveyed the damage, in several cases, received from the groundings incidental to the service they are in. After the most careful and thorough investigations and calculations, it has been found that the conclusions reached by the association previous to the addition to its rules of provisions for this form of construction, have been amply confirmed. The "channel" vessel, in practice, has proved stronger than a vessel of the same dimensions and weight of materials with riveted angle frames and reverse frames, with a materially increased cargo carrying capacity. The first item possesses the greatest significance to the association and the underwriters interested in its work, while the second, in connection with it, is of the greatest importance to the owner. As Professor McDermott points out in his detailed report, a "channel" vessel can "be either for the same sectional area of material stronger, or for the same strength she can have less sectional area and consequently less weight than a vessel built on the old system." For the full meaning of this result to the owner, I would refer you to his report. The same result is also indicated in the letters from Mr. Babcock, Mr. Wallace, Mr. Shaw and others, which follow.

As to the results in cases of grounding, it is, no doubt, very well known to you as an underwriter, that the steamers in the iron ore trade on the lakes take the ground very frequently in passing through the connecting rivers and canals when loaded to the present maximum draft, and very serious damage often results. It has been found by actual experience that the damage to the bottom of the channel vessel is of a purely local nature and does not "spread" and affect other parts of the structure at a distance from the point of contact as readily as in vessels of the ordinary construction, and can be more readily and cheaply repaired.

I may say, in conclusion, that the association has introduced an improvement in ship construction that benefits owners, builders and underwriters, and will, in time, receive all the credit it deserves for its progressiveness and active interest in the development of our ship building.

Respectfully yours,

JAMES F. FOX, Esq.,
President.

SINCLAIR STUART,
Surveyor.

CHICAGO SHIP BUILDING COMPANY,
CHICAGO, March 1, 1895.

JAMES F. COX, Esq., President U. S. Standard Steamship Owners', Builders' and Underwriters' Association, Limited, 16 Exchange Place, New York, N. Y.:

DEAR SIR:—Your favor of the 20th ult. asking our opinion of the channel system of construction for framing of vessels, was duly received and in reply we beg to say that, from our experience, we regard it as a great improvement over the ordinary form. During the last year we have applied this system partially in a large steamer and wholly in two large barges, and have now under construction two steamers and one barge, all of the very largest class for lake service, in which we are using channels, not only for floors and frames, but also for all belts, side stringers, chocks, deck beams and ties.

We are of the opinion that the same strength can be obtained, with a considerable reduction in weight, by the use of channels instead of plates and angles riveted together, on account of the former being in one solid piece. Riveted connections, however good the workmanship, are liable to loosen under constant strains, while the rivet holes weaken the material, reduce the available section and necessitate points of minimum strength at which fractures will always start. With channel floors and frames, much better workmanship is not only possible but certain in the fitting of all longitudinals, side and deck stringers and all chocks connecting same to shell, from the fact that as each floor, frame or chock is in a single piece, the moulded dimension is constant, the line of their inner surface is fair if the bevels are correct, and angle or other bars fitted against them take an equal and exact bearing, iron to iron, on every one. The strength of any structure composed of various pieces riveted together, like the hull of a ship, depends very largely on this excellence of fitting and the friction alone between any two surfaces of metal drawn together by rivets so as to bear hard against each other, is a very important addition to the strength of the connection. When the framing of a ship is composed of separate pieces riveted together, it is impossible to keep the resulting moulded dimension constant, and therefore, the stringers cannot in practice be fitted so as to get that uniform hard bearing on each frame or floor which is so important.

In our very flat bottomed lake vessels, running constantly through shallow rivers and harbors and frequently touching the bottom, even though but lightly, the use of channel floors gives much more local

strength to the bottom plating and avoids the breaking of frames through the rivet holes and shearing of rivets connecting frames and floor plates, which is now very common. From the less number of pieces to handle and the reduction in the number of rivets required, we also find the cost of the framing is less with this than with the old system. For all these reasons we are heartily in favor of the channel system and would sum up its advantages as follows:

Greater strength with less weight, because the strength is solid instead of built up, and better workmanship is certain; faster and cheaper construction. All these points are most important in the development of the art of ship building.

Yours truly,

(Signed) W. I. BABCOCK, Manager.

OFFICE OF THE HARLAN & HOLLINGSWORTH COMPANY,
WILMINGTON, DEL., January 10, 1895.

JAMES F. COX, Esq., President U. S. Standard Steamship Owners', Builders' & Underwriters' Association, Limited, New York.

DEAR SIR:—Mr. Sinclair Stuart has requested me to write you expressing my opinion of the channel system of framing for ships. I cannot speak from experience on this subject, from the fact that we have built no vessels under this construction, but I have gone carefully into the matter of late and can safely say as far as strength is concerned, the channel system as required by the United States Standard rules, is much stronger than the angle iron construction, principally in the fact that the frame is not weakened by the punching of holes in the standing leg for the attachment of the reverse frames, less number of rivets in floors, frames, etc., to work and get loose. As to the weight saved, this depends largely on the style of vessel being built; for instance, if the ship is a heavy carrier of full model, such as are usually built on the lakes, where the amidship frame is carried the same shape well towards the ends, the saving in weight is quite an item, for the reason that where the frames begin to close in to form the ends, the single iron system must be resorted to; in other words, the greater the length that the channel system can be carried the greater the saving in weight. But in a finer modeled ship, where speed is the essential quality, the channel system cannot be carried for any great distance. In a ship I have just estimated the weight for under the two systems, the saving in favor of the channel system was only 200,000 pounds in a total of 3,600,000 pounds; but the ship is for a speed of 17 knots and of very fine model, and the channel construction could only be carried for about three-fifths of the vessel's length.

There is no question as to the channel system being the cheaper as far as the labor is concerned, for the following reasons: You have no punching or riveting for floors, reverse frames, keelsons, and many other places; also less number of rivets to drive. The channel system is better adapted to the water bottom type of ship than one having no water bottom.

In conclusion, I would say, the British Corporation rules allow about 20 per cent. in favor of channel frames as compared with the angle frames and reverse frame. Lloyds also allow a large reduction in the use of channels. Channel floors have no bottom rivets to shear on the edge of the floors. Longitudinals extending over the floors and riveted to same and to water ballast tank top, make a stronger connection than the topsides or intercostal would be. Channel stanchions are stiffer and lighter than the round iron and make a better connection at the top and bottom than the latter. Trusting I have covered the ground satisfactorily, I remain,

Very truly yours,

T. JACKSON SHAW, Superintendent.

UNION DRY DOCK CO.,
BUFFALO, N. Y., Feb. 21, 1895.

JAMES F. COX, Esq., President U. S. Standard Steamship Owners', Builders' & Underwriters' Association, Limited, New York:

DEAR SIR: Answering your request that I give my opinion on the channel system of construction I beg to say that I consider it the best idea that has been presented for the solution of the problem of constructing good ships cheaply.

I am well pleased with the future prospects of ship building in this country with materials of this kind at our hands for their construction, as there is no question in my mind as to the strength of the various parts of the ship constructed by using channels, as compared with the ordinary practice of connecting angles and plates together with rivets.

It is better for the ship owner, for he can get a ship built for less money and one that will carry more cargo; better for the ship builder, for he can better compete with other countries on account of the saving in labor and build an equally good ship; and it is better for the underwriter, because I verily believe that he will be called upon to pay for less damage to floor plates, angles and frames through grounding or other collision.

I am an enthusiastic convert to the system and consider it far ahead of any other construction that I know of.

Yours very truly,

EDWARD GASKIN, Superintendent.

NEW YORK, Feb. 23, 1895.

MR. JAMES F. COX, President United States Standard Steamship Owners', Builders' & Underwriters' Association, Limited, New York:

DEAR SIR.—As requested, I have made an examination into the requirements of the various classification societies regarding the framing of steel vessels and find that the use of channel sections for the purpose, which is allowed by your association, is sanctioned by all the important societies, or rather, judging from the reduction in weight allowed, evidently preferred to the riveted angle frames and reverse frames or any other form in use.

Table No. 2 of the British Corporation rules allows a reduction of 20 per cent. in favor of the channel section.

Lloyds' rules also, Table G. 1, allow a large reduction for channel frames.

The superior shape of the channel section, in my opinion, fully warrants such reductions. It must be apparent that the standing flange of the channel remaining solid and free from rivet holes, affords greater strength.

I believe the channel can also be used to greater advantage in other parts of the construction, as your rules provide. I would mention the following parts and the advantage gained in each:

FLOORS—Channel floors are without rivets to sheer on the edge and both angles are rolled on the floor frame forming the floor.

LONGITUDINALS—A stronger connection can be obtained with longitudinals extending over and riveted to the floors and to water ballast tank top, and if necessary, to bottom plating.

BEAMS—Channel beams are superior to bulb beams in that the flanges are better adapted for riveting an iron deck, or laying a wooden deck on same, and will bear a greater weight at a given length of beam; and will also make a stronger connection to the ship's frame.

STANCHIONS—Channel stanchions would be fully 15 per cent. stronger as supports for beams, than round stanchions; a better connection can also be made in riveting to beams.

It is my opinion that any vessel built with channel sections for all the above mentioned parts, and in accordance with the United States Standard rules adopted at our last meeting to govern this system of construction, would be stronger than the old construction of frames and reverse frames.

Very truly yours,

(Signed) B. C. BAMPTON,
Supt'g Engineer Columbian Line,
Ex-Supt'g Engineer Pacific Mail S. S. Co.,
Member Consulting Committee of Engineers.

OFFICE OF THE MORGAN IRON WORKS,
New York City.

JANUARY 9, 1895.

JAMES F. COX, Esq., President U. S. Standard Steamship Owners', Builders' & Underwriters' Association, Limited, New York.

Dear Sir: At the request of Mr. Sinclair Stuart, I write you regarding our opinion as to the relative strength of channel iron frames and angle frames and reverse bars riveted together for ship construction.

We are now preparing plans and estimates at the ship yard at Chester, for a freight and passenger steamer, 326 feet keel, 47 feet beam, 28 feet 10 inches depth of hold, to have channel frames, beams, floors and stanchions. As the English Lloyds, Bureau Veritas, British Corporation and United States Standard Register all allow a reduction in weight in favor of channel frames, and, considering the well known conservatism of these classification societies, I regard this discrimination as conclusive proof of the advantage in strength of the channel frames. In full modeled, water ballast tank vessels, the superiority of the channel frames, in our opinion, will be still more apparent.

Very truly yours,

GEO. E. WEED, President.

Hendrick's' Architects' Guide and directory for 1895-6 is the best work of the kind published. The lists of architects and of concerns manufacturing or handling all kinds of building material are very full and accurate. It contains the names of 11,500 brick manufacturers, 60,000 carpenters and builders, and the total of all firms represented in 1,000 pages of the book is 220,000. It is valuable to any one having anything to do with building industries. The price is \$5 and it can be ordered through the MARINE REVIEW.

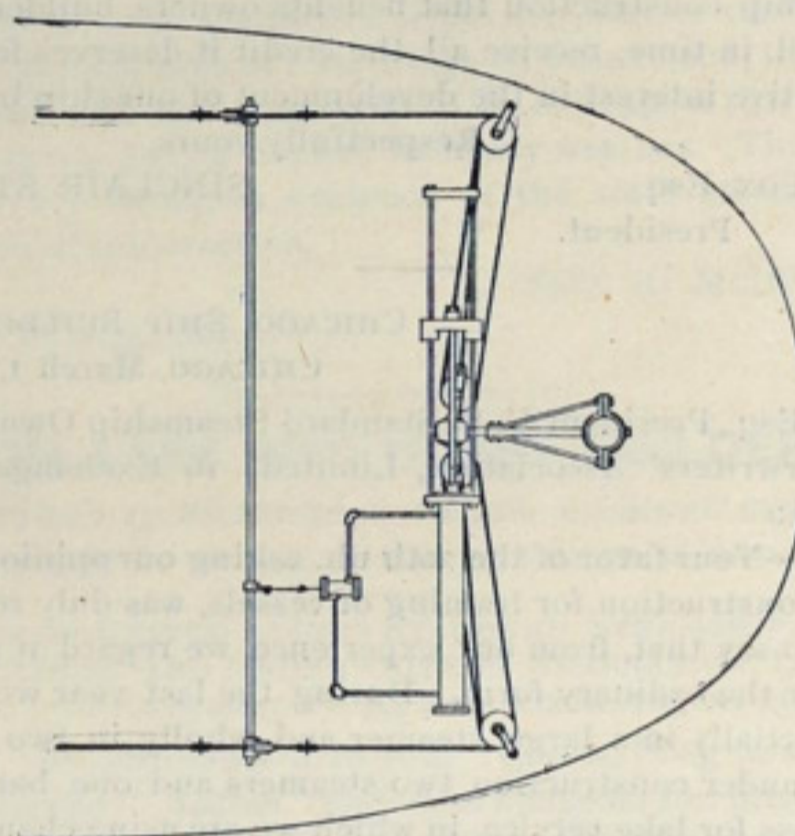
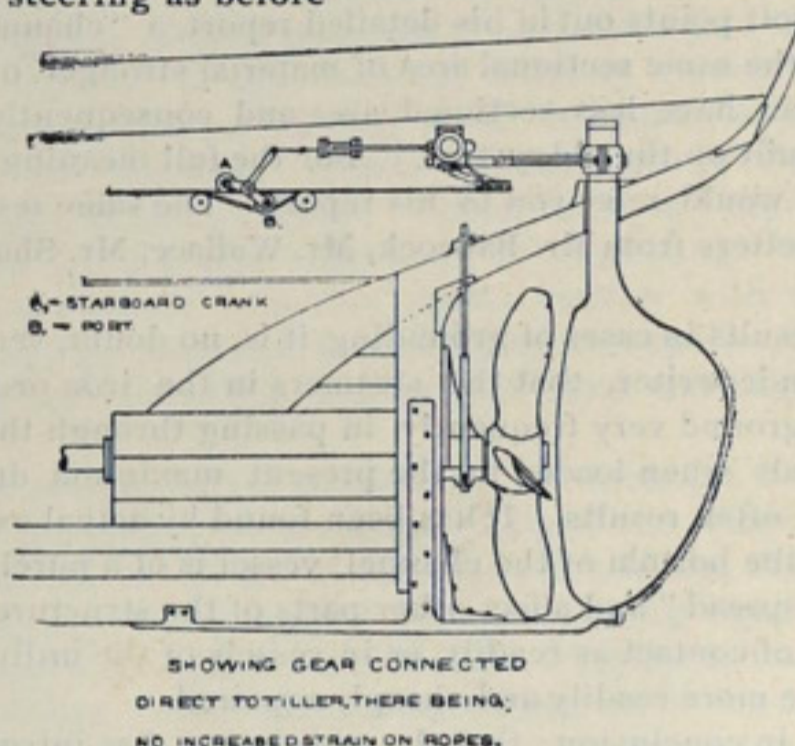
Captains and sailors wishing to join a vessel at any Lake Michigan port, either shore, can make good time and secure reasonable rates from Detroit over the Detroit, Grand Haven and Milwaukee Railway, which has two good passenger steamers running daily between Grand Haven and Milwaukee. Berths in the staterooms are free to first class passengers. Leaving Detroit at 2:42 p. m., passengers are landed in Milwaukee at 6 o'clock the next morning.

ALL NEW HYDROGRAPHIC CHARTS ARE KEPT IN STOCK BY THE MARINE REVIEW, 516 PERRY-PAYNE BUILDING, CLEVELAND.

Cincinnati Steam Steerer.

The Cincinnati steam steerer, as manufactured by a Cincinnati firm, has been used on the lakes for two years past in the steamers Nebraska and Geo. H. Dyer. The sale of this gear on the lakes has now been taken up by the Frontier Iron Works of Detroit, a firm of engine builders well known to the lake trade. The Detroit people say that deficiencies found in this steerer during the first season's use of it here have been made good, and they offer it as a cheap and effective gear that will go into "any old place" about a boat and be of little bother in its operation. In a letter to vessel owners they say:

"If you have any special idea as to reeving of wheel ropes, or location of purchase, we can make the gear to suit, and we will guarantee it to give satisfaction as long as you let us determine the diameter and length of cylinder and diameter of steam and exhaust pipes. We can connect to your wheel chains direct or by means of a gun-tackle purchase, or we can put in an independent purchase and quadrant, or we can connect direct to your tiller, in every case leaving your wheel ropes in place and available for hand steering as before."



"The peculiar feature of the principle of which this gear operates, is its great range of adaptability. The first gear made consisted of two cylinders, one on either side of the boat, and working with steam on but one end. This has been modified so that but one cylinder is used, taking steam at either end. The valve is separate from the cylinder and may be placed at quite a distance from it, though this is not to be recommended, as it is more wasteful of steam. All the attention that this gear requires from the engineer, is a small quantity of cylinder oil regularly supplied. An oil pipe can be run to the engine room, and a small hand pump attached, or it can be piped to the main hand oil pump. All other oiling belongs to the deck department and should be done whenever the wheel ropes are inspected and greased. If five pounds of steam will not handle the rudder, the valve will continue to give it more until the pressure does handle it, and the same in case the rudder is moved by an outside force, the pressure increases until it is sufficient to overcome whatever force is acting and throw the rudder back to its original position."

THREE BOOKS OF SAILING DIRECTIONS, ONE COVERING LAKE SUPERIOR AND THE ST. MARY'S RIVER, ANOTHER COVERING LAKE MICHIGAN AND THE STRAITS OF MACKINAC, AND A THIRD TAKING IN LAKES HURON AND ST. CLAIR WITH DETROIT AND ST. CLAIR RIVERS, ARE NOW OFFERED FOR SALE BY THE HYDROGRAPHIC OFFICE. THESE BOOKS ARE PARTS OF A WORK THAT WILL COVER THE ENTIRE CHAIN OF LAKES. THEY CONTAIN CHARTS OF LEADING CHANNELS AND HARBORS, AND MAY BE HAD FROM THE MARINE REVIEW, 516 PERRY-PAYNE BUILDING, CLEVELAND, AT \$1 EACH.

MASTERS OF LAKE VESSELS CAN NOT WELL AFFORD TO BE WITHOUT THE NEW CHARTS. EXAMINE THEM AT THE OFFICE OF THE REVIEW.

Steel Schooner Proposed by the Barge Company.

With steel ship yards on the lakes fast filling up on contracts for new ships, it is more than probable that the plant of the American Steel Barge Co., at West Superior, which up to this time has been confined largely to work on account of the barge company, will be found building vessels on orders from outsiders. The West Superior concern is in a position to take orders at an opportune time, and there is, of course, no doubt of its facilities to meet any requirements that may offer fair prices for building. The oil barges recently constructed for the Standard company are very trim vessels, and although difficulty is frequently encountered in making these tank barges tight, they have now made half a dozen trips and it has not been necessary to tighten even a rivet in them. The dry dock portion of the barge company's plant has been busily engaged on repair work for some time.

Capt. Alex. McDougall was in Cleveland Tuesday, and he had with him plans showing a midship section and the general arrangement of a schooner-rigged tow barge, which were gotten up after a hard scrutiny of what other builders and owners are doing on the lakes. Negotiations are now pending for the construction of at least two vessels of this kind. Engravings from these plans were to have been prepared for the REVIEW but they were delayed. They will be printed next week.

The vessel will be 337 feet over all, 326 feet between perpendiculars, 42 feet moulded beam and 26 feet moulded depth. The plans include steel masts, but wood may be substituted or spars dispensed with altogether. Plating and framing will be about the same as in steamers of the largest class. Other features of construction are beams on alternate frames, stanchions on all beams and half-inch lower flush steel floor, the same as in the steamer John B. Trevor, which was the first vessel to adopt steel floors for cargo purposes.

It is expected that this ship will carry 3,685 net tons on 14 feet draft. Approximate figures regarding her capacity at different stages of water up to 18 feet are: At 14 feet 6 inches, 3,844 net tons; 15 feet, 3,999; 15 feet 6 inches, 4,159; 16 feet, 4,321; 16 feet 6 inches, 4,485; 17 feet, 4,651; 17 feet 6 inches, 4,819; 18 feet, 4,989.

Around the Lakes.

Tonnage of the steamer Yale, as fixed by the United States bureau of navigation, is 3,453.26 tons gross and 2,698.58 net. Her official number is 27,665.

O. W. Blodgett of Bay City has purchased from Isaac Stephenson of Marinette, Wis., the big lumber barge Peshtigo. The price is reported at \$30,000.

A general overhauling and repairs to engines are being made at Detroit on the Mackinaw car ferry Sainte Marie, by her builders, the Detroit Dry Dock Co.

Capt. William H. Pringle, who brought out the big steamer Onoko and who has been living at San Diego, Cal., for a number of years, is visiting friends on the lakes.

A steam fog whistle is now in operation at Seul Choix point light station, Lake Michigan. Blasts are of 3 seconds' duration separated by silent intervals of 17 seconds.

During August the river mail service at Detroit delivered to passing boats 4,736 letters, as against 4,406 letters in July, and received from the vessels 2,553 letters, as compared with 2,527 in July.

Although the first ore cargo of the big steamer Yale, 4,181 net tons from Escanaba, is a large load, it is considerably short of what the larger boats now building at several lake yards will carry.

A speed of twenty-one miles an hour is claimed for the Northern line passenger steamer North Land on her last trip down Lake Superior from Duluth to the Sault. She is said to have made the run in 19 hours 45 minutes.

As a result of the recent harbor tug accident at Duluth, the city council has passed an ordinance limiting the speed of vessels within the harbor to five miles an hour, and providing severe penalties for violation of the regulation.

Capt. George Crawford of the steamer City of Holland, died aboard that steamer on Lake Michigan, a few days ago, from injuries sustained by being crushed between the dock and his vessel, in trying to save a bale of wool that was being unloaded.

During the month of August the Mutual line steamer Cambria loaded seven cargoes of ore at Escanaba, all of which were delivered at Ohio ports. This does not mean, of course, that the steamer made seven round trips during the month, but she was close to that record.

Capt. David Becker of Cleveland, who died in Port Colborne a few days ago from injuries sustained in the burning of the steamer St. Magnus at that port, was the father of Capt. Becker, who was for a number of years engaged as a vessel broker in Cleveland with Capt. Geo. Warner.

Another salvage case that will probably result eventually in the

claim involved being cut in two was begun in Duluth, Monday, when the Western Transit Co., owners of the steamer Arabia, libeled the G. G. Hadley and her cargo of wheat for \$12,000. The Hadley lost her rudder on Lake Superior on Friday last and was picked up by the Arabia.

Members of the firm of Corrigan, McKinney & Co., Cleveland, say they have no business connections with Ferdinand Schlesinger. They are annoyed by stories of the kind sent out from Milwaukee a few days ago to the effect that they are associated with Schlesinger in the purchase of the Germania, Windsor, Pence and other properties on the Gogebic range.

The 400-foot steamer Victory arrived in Ashtabula Tuesday morning with a little more than 3,400 gross tons of ore (14 feet draft) and on Wednesday morning left with a full load of soft coal. The work of unloading ore was begun at 6:30 Tuesday morning and at 7 o'clock Wednesday morning the steamer left the car dumping plant with her coal cargo. The working time for both cargoes was 18 hours.

South Chicago will soon have seven grain elevators, with storage capacity for 10,000,000 bushels of grain. Two of the elevators are controlled by Bartlett, Frazier & Co., two by Hornstein Bros. and three by Charles Counselman. The erection of these elevators will give Chicago and South Chicago a combined storage capacity of over 40,000,000 bushels of grain, and should emergency exist, room for 10,000,000 bushels more can easily be secured by using all the small private elevators in various parts of the city.

Although James Reed, well known wrecker, announces that he is to go ahead with preparations for raising the steel steamer Cayuga, sunk near Skilagalee light, Lake Michigan, some time ago in collision with the steamer Hurd, Philadelphia representatives of the foreign underwriters say that no contract has as yet been let for the work. Messrs. Murphy and Reed both submitted bids on the work, agreeing to accept either a percentage or take a lump sum in event of success, with nothing if their efforts failed, but the announcement that Capt. Reed has secured a contract through foreign parties is probably premature.

The steamers Zenith City and Victory, described in this issue, each have two 8-kilowatt generating sets and the installations were made by the Chicago Ship Building Company, under United States Standard Register rules. The marine watertight naval core wire was used throughout.

Mr. J. W. Kellogg, representing the General Electric Co., has been calling on a number of ship-builders during the week.

THREE BOOKS OF SAILING DIRECTIONS, ONE COVERING LAKE SUPERIOR AND THE ST. MARY'S RIVER, ANOTHER COVERING LAKE MICHIGAN AND THE STRAITS OF MACKINAC, AND A THIRD TAKING IN LAKES HURON AND ST. CLAIR WITH DETROIT AND ST. CLAIR RIVERS, ARE NOW OFFERED FOR SALE BY THE HYDROGRAPHIC OFFICE. THESE BOOKS ARE PARTS OF A WORK THAT WILL COVER THE ENTIRE CHAIN OF LAKES. THEY CONTAIN CHARTS OF LEADING CHANNELS AND HARBORS, AND MAY BE HAD FROM THE MARINE REVIEW, 516 PERRY-PAYNE BUILDING, CLEVELAND, AT \$1 EACH.

A CHART COVERING LAKE HURON, GEORGIAN BAY AND THE STRAITS OF MACKINAC, ALL ON ONE SHEET, HAS BEEN ISSUED BY THE HYDROGRAPHIC OFFICE AND MAY BE HAD FROM THE MARINE REVIEW AT 75 CENTS. LAKE SUPERIOR ON ONE SHEET AND LAKES ERIE AND ONTARIO IN THE SAME FORM ARE ALSO IN PRINT AND SELL AT THE SAME PRICE.



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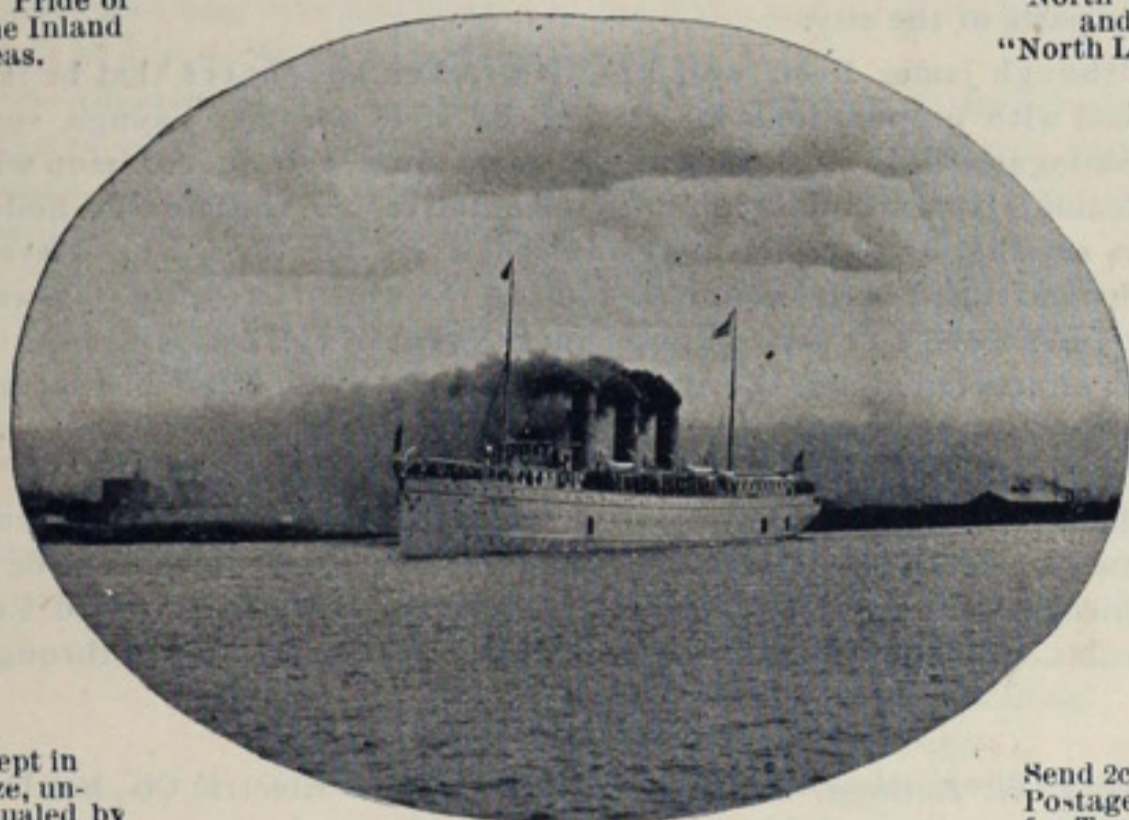
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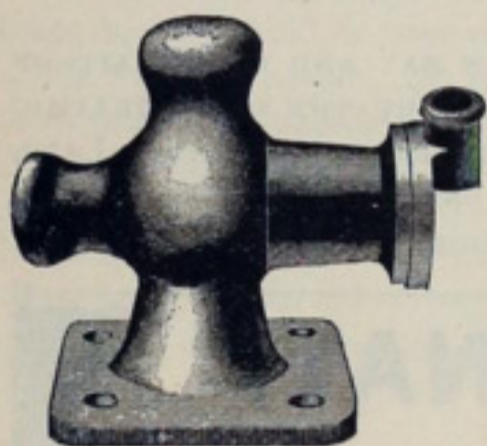
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FRANK S. MANTON, AGENT.

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For Signal Lights and Illuminations of all kinds.
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We call the attention of masters of vessels to the efficiency of our patented flare-up or flash light torch. It can be used with kerosene or spirits of turpentine. Its superiority over all other kinds of torches is that it is indestructible. Being filled with asbestos, it will last for years, and is ready for use at any moment. It gives a white flame three to five feet high, burns less liquid than any ordinary torch of the same size or larger. The combustion is so perfect that very little smoke is made, and the flame is therefore much brighter. At night you can wigwag with this torch. Rain or spray will not extinguish it, and the stronger the wind the better it burns. We have also a **Blue, Green and Red Burning Liquid**, to make any code of signals required. Yachtsmen will find this of immense value for signaling.

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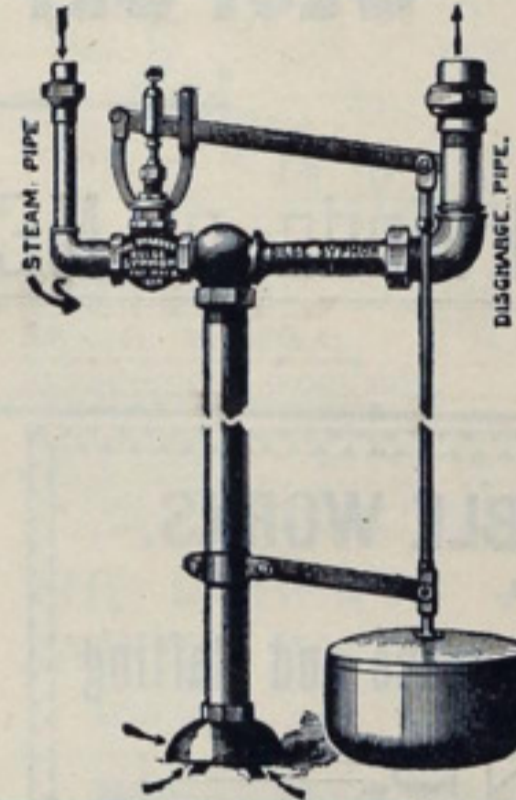
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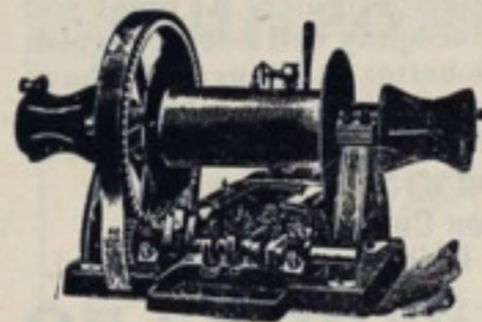
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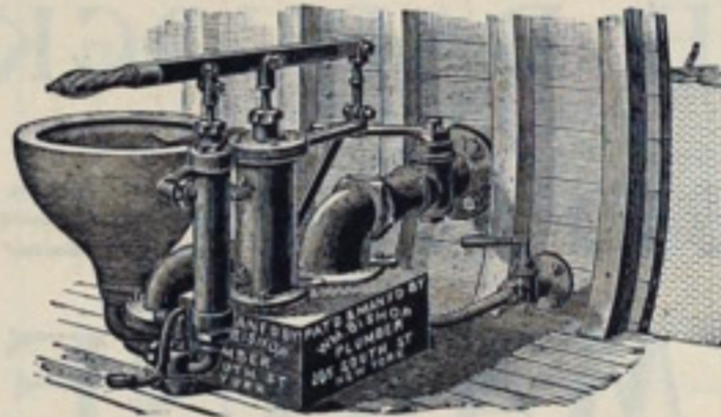
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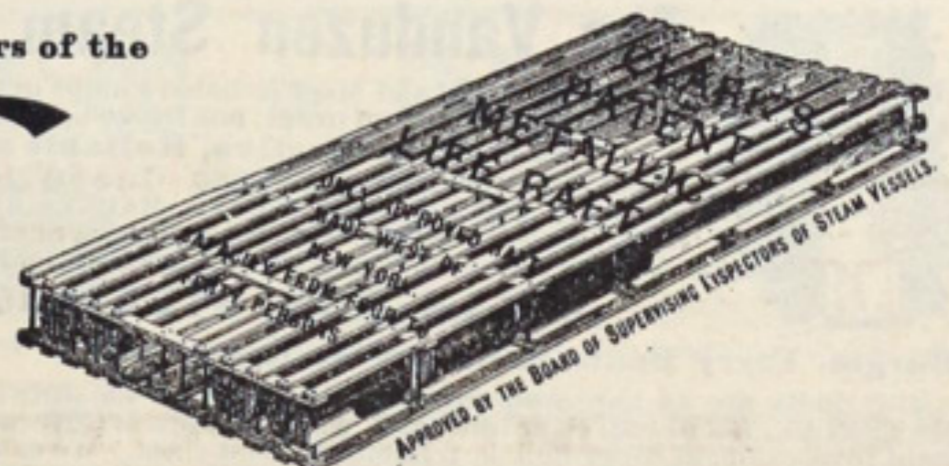
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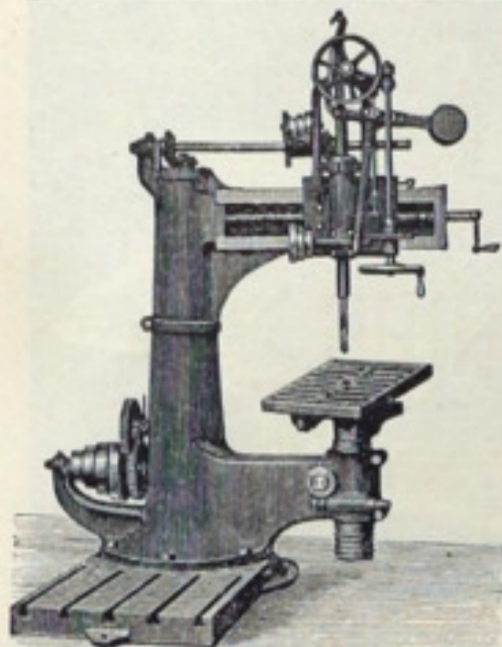
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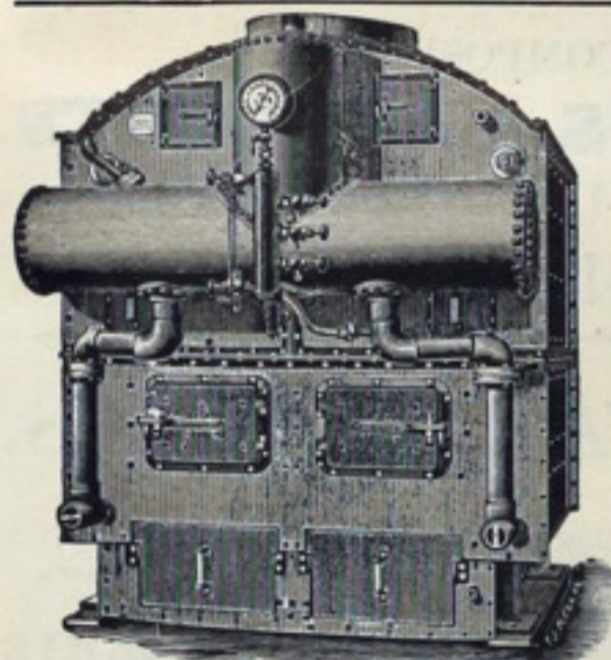
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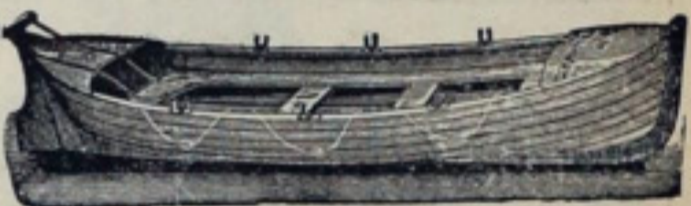
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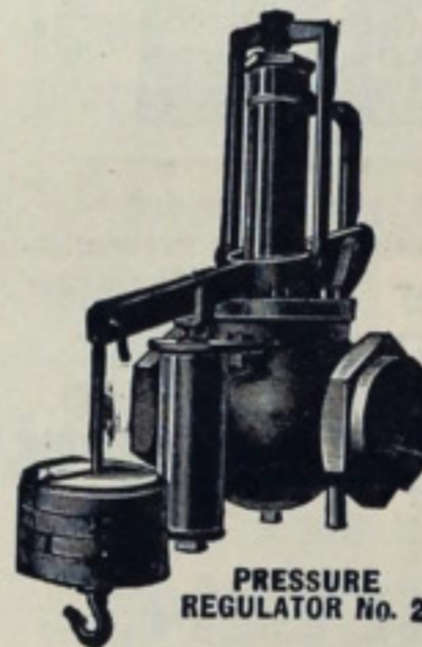


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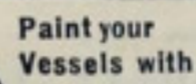
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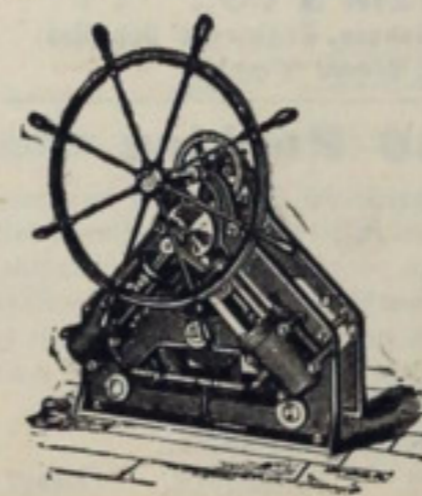
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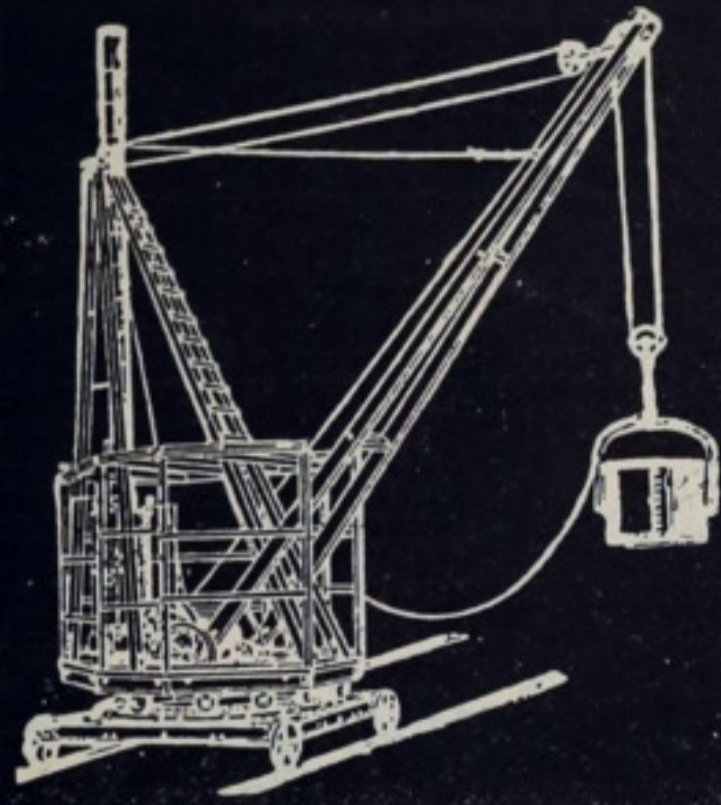
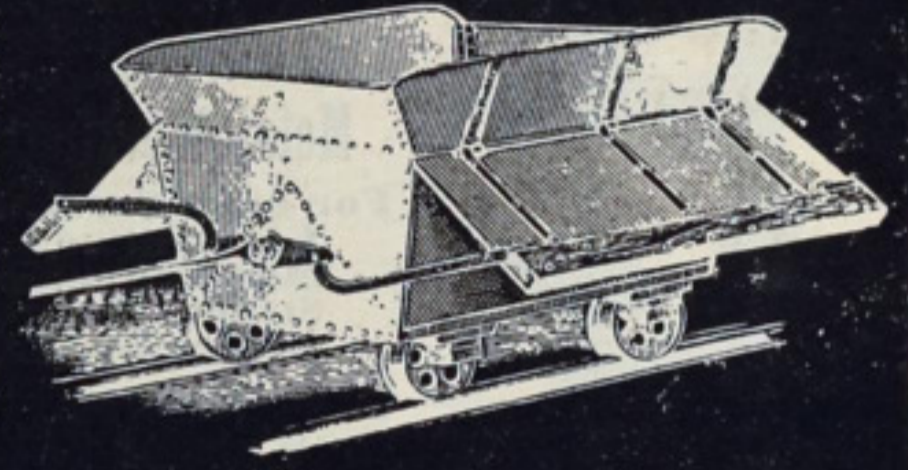
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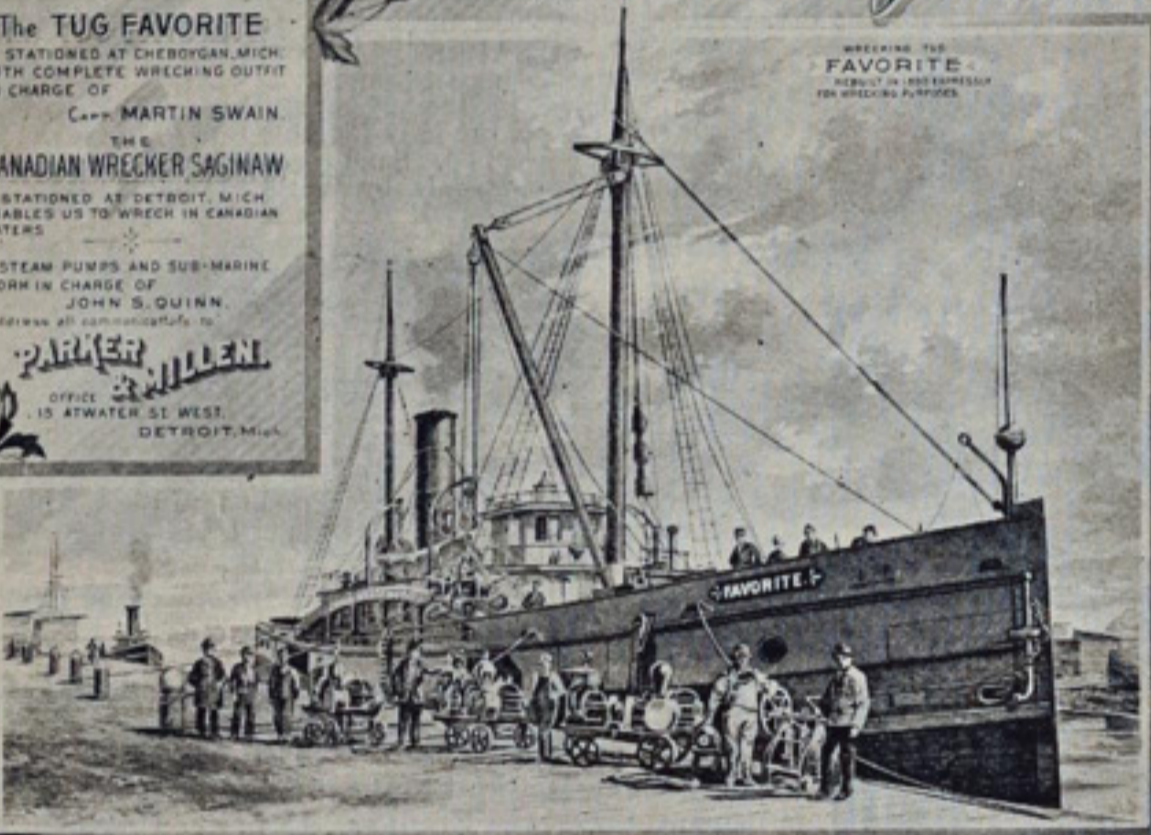
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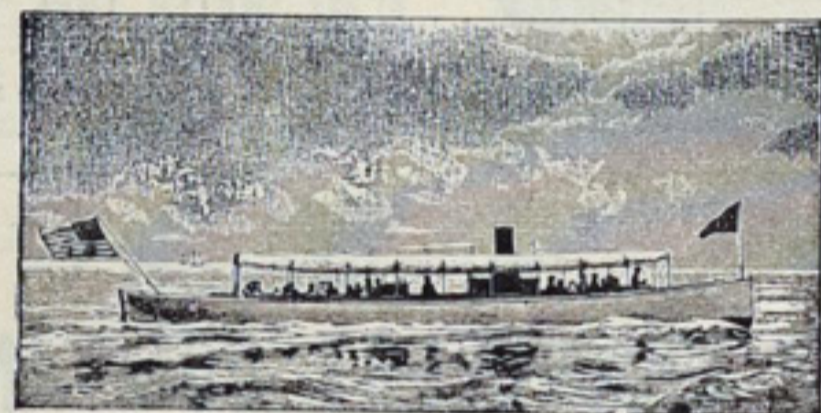
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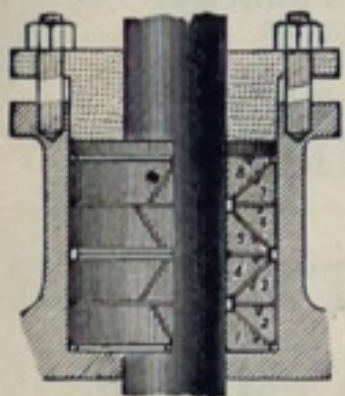
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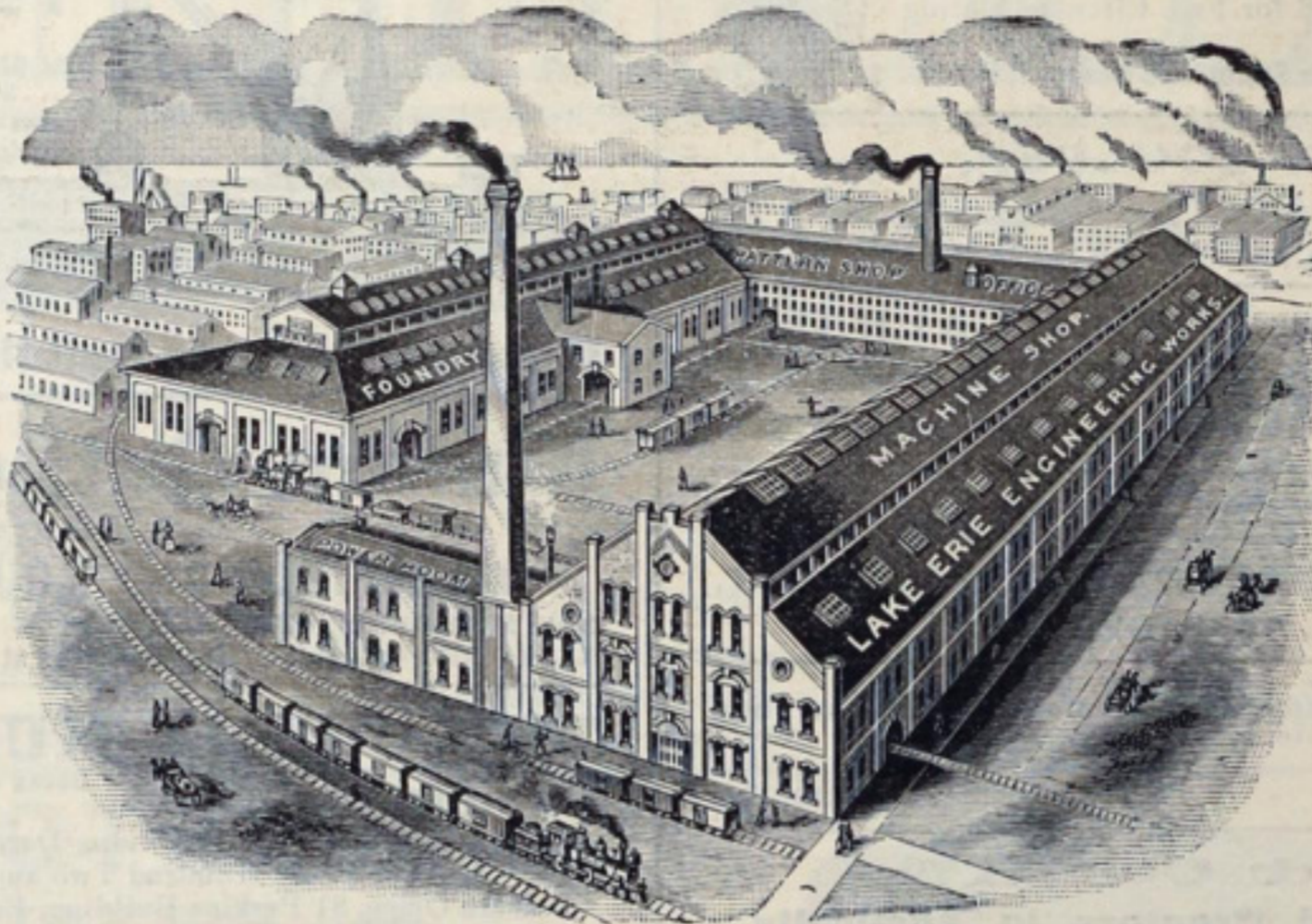
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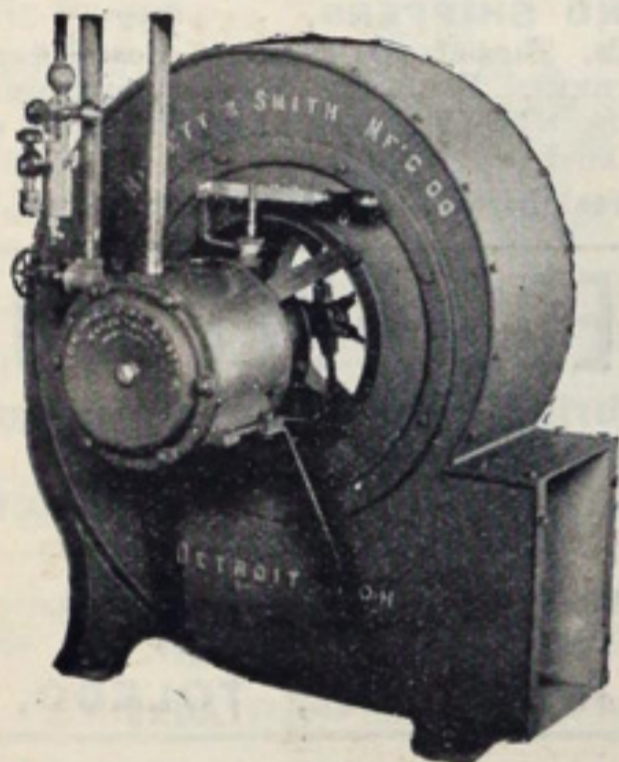
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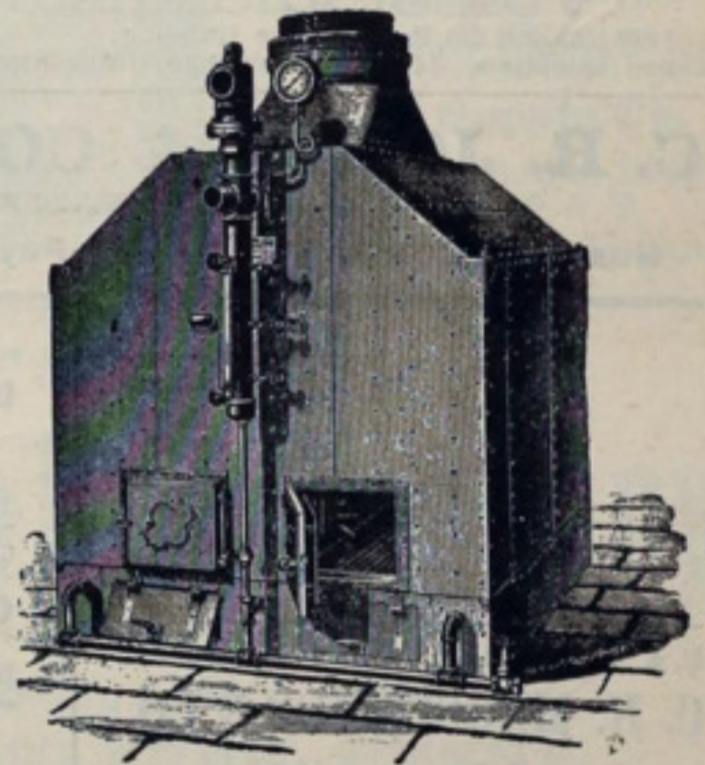
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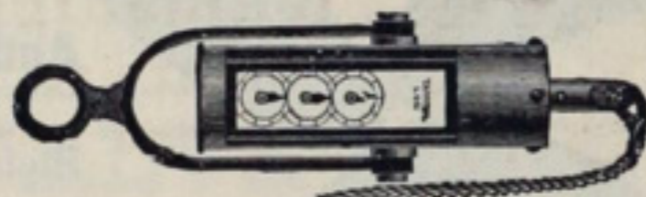
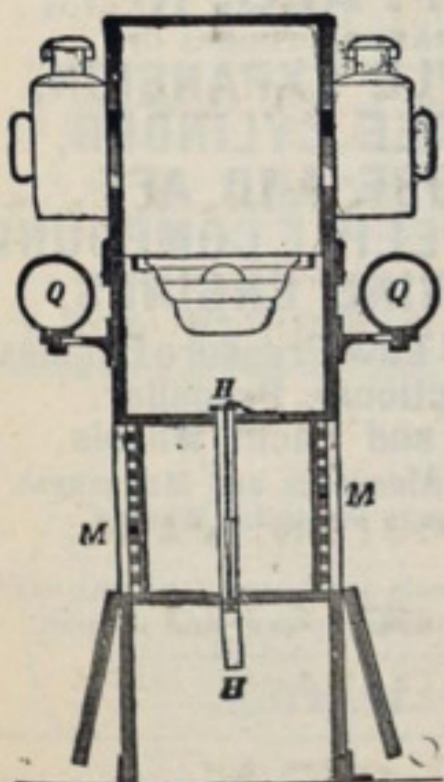
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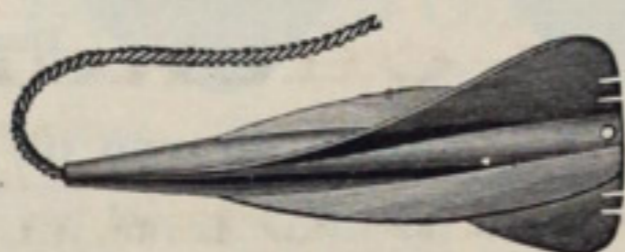
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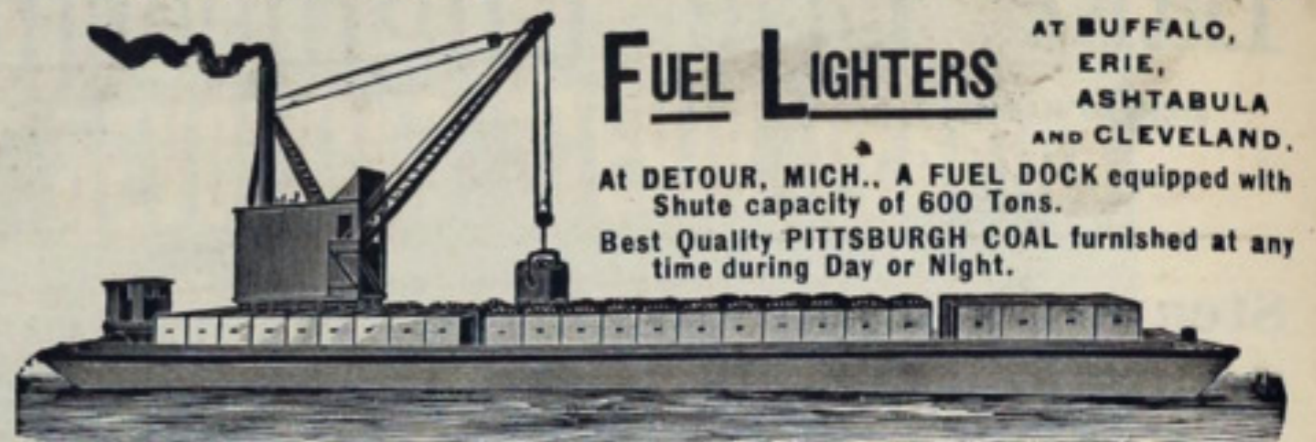
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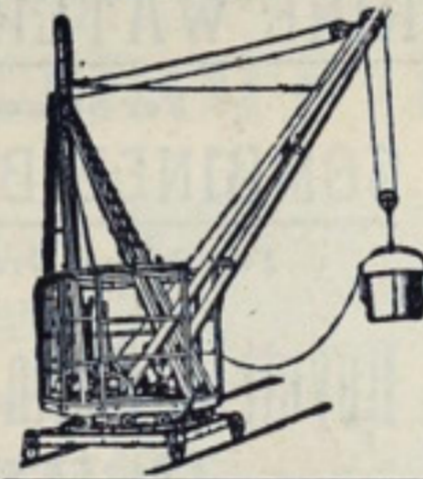
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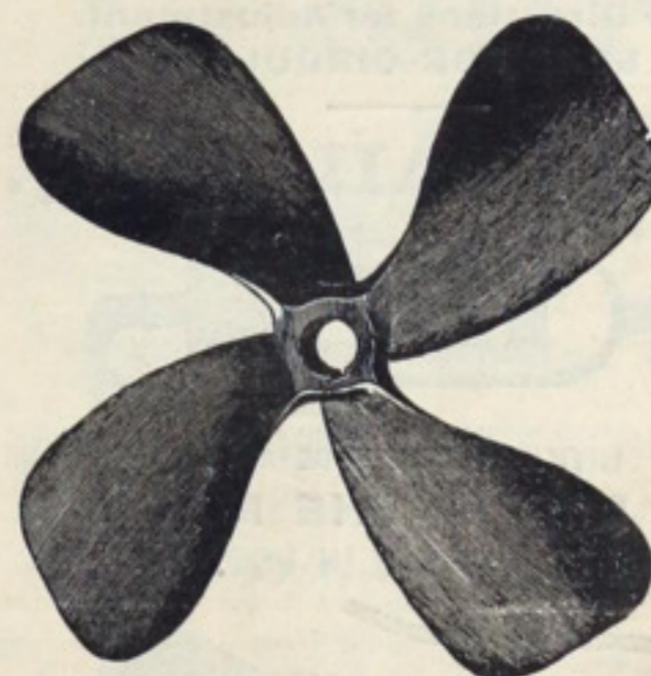
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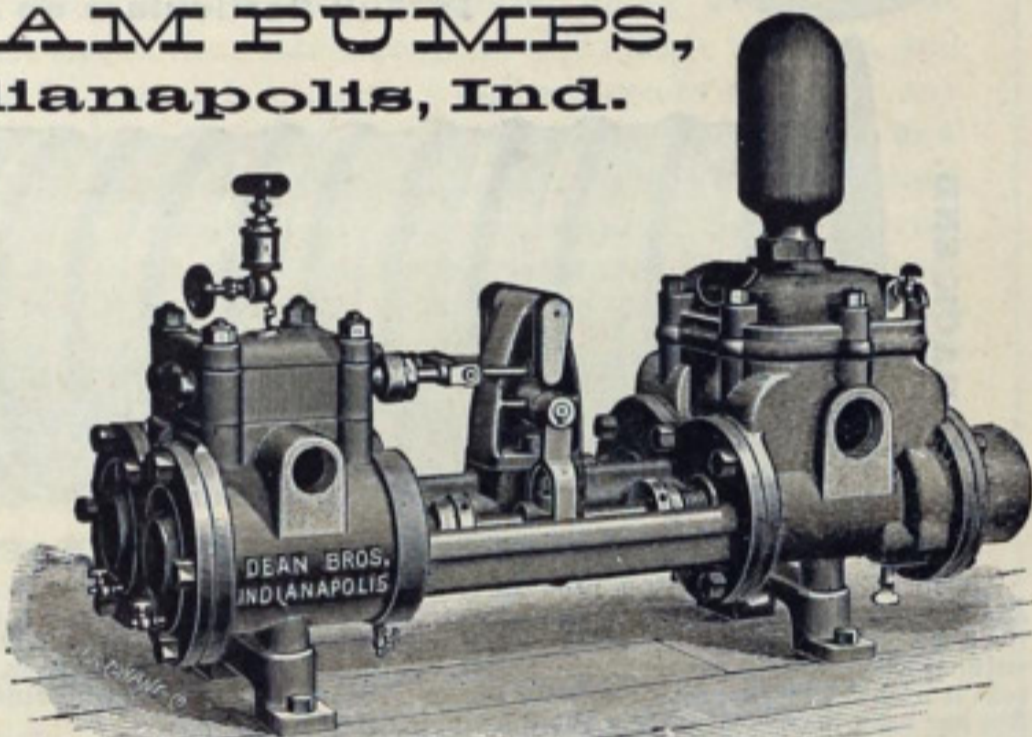
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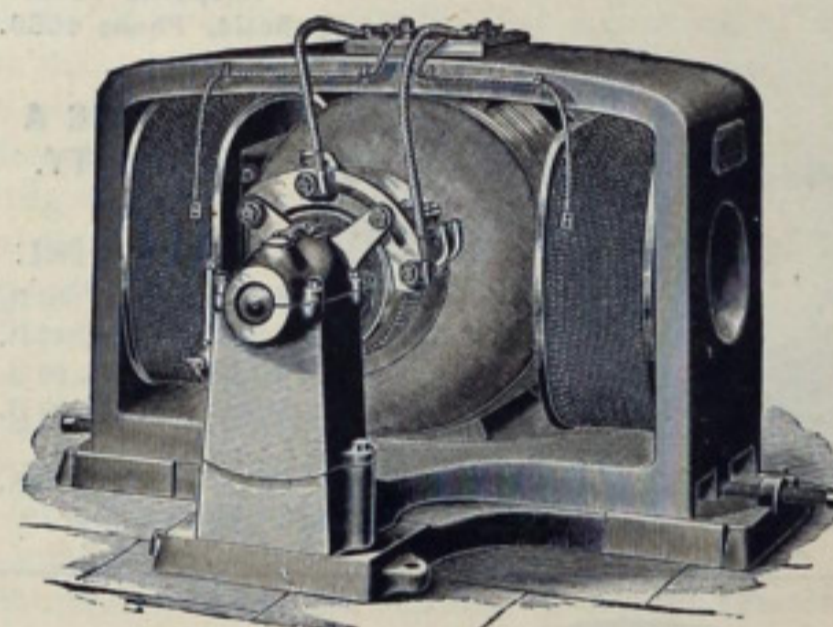
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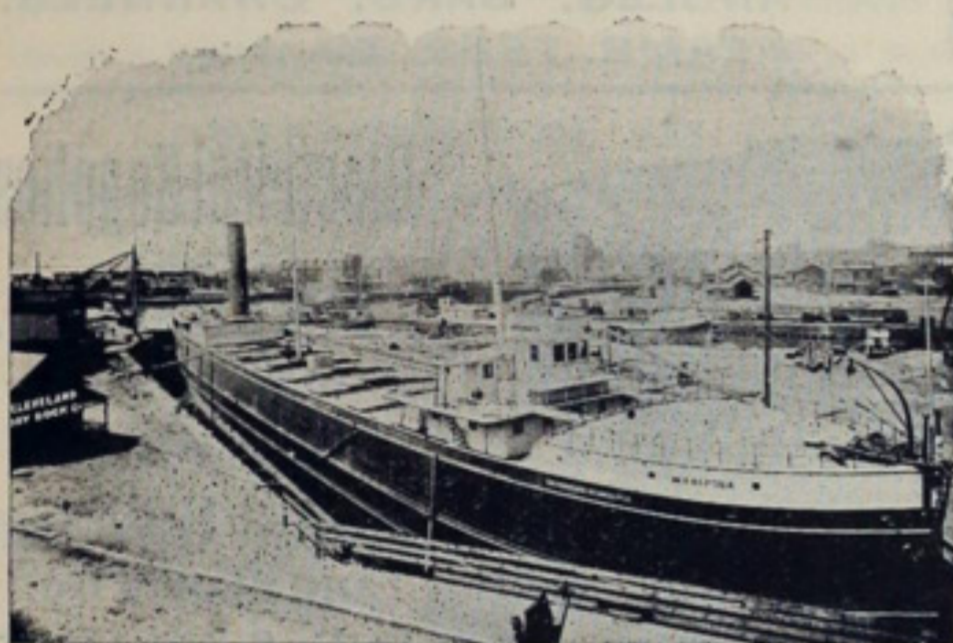
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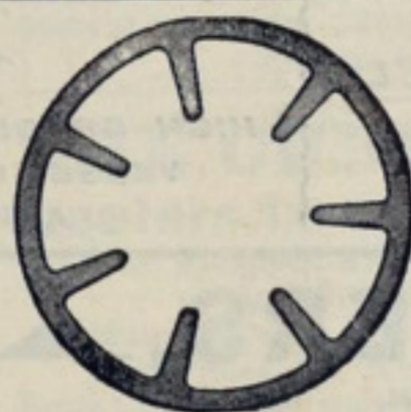


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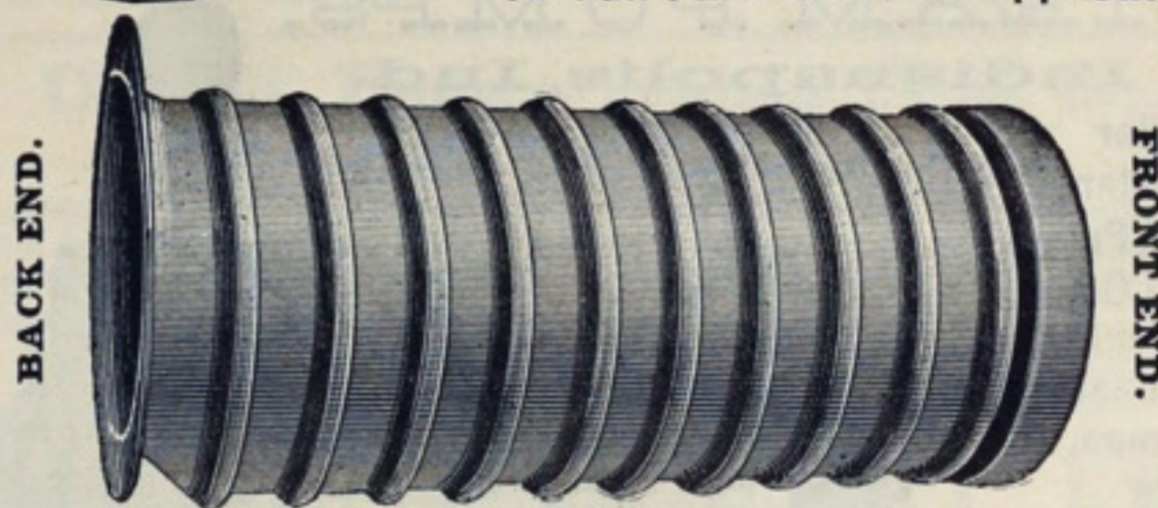
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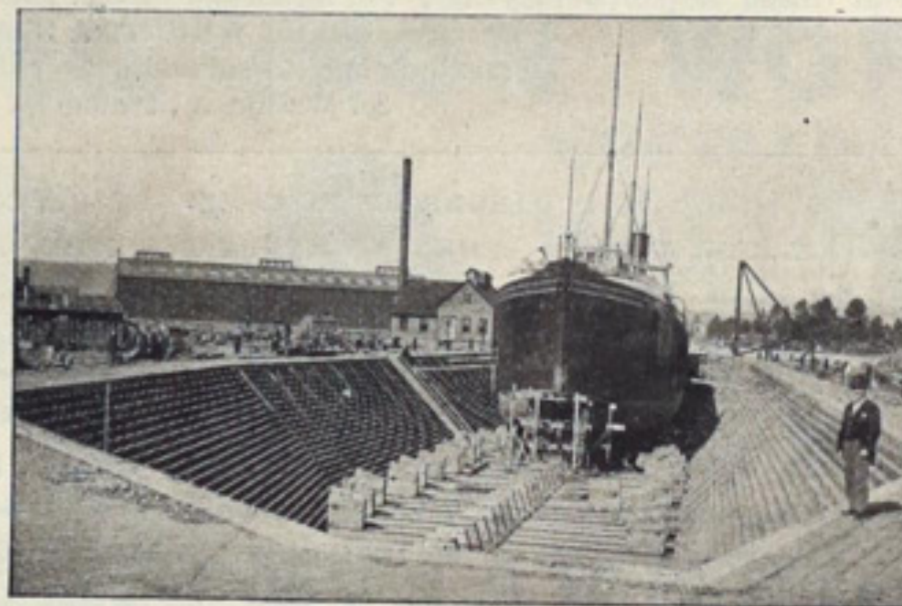
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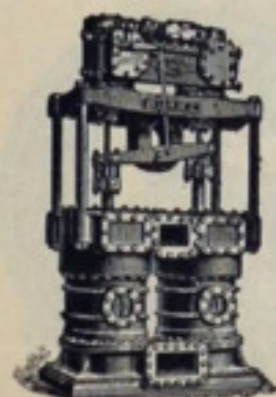
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